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Sustainability, Innovation, and Human Development: New Interdisciplinary Paths

by *Antonio Garofalo*

In the current global scenario, sustainability emerges as one of the key interpretative dimensions through which to analyze the economic, social, environmental, and cultural changes characterizing the 21st century. The intensification of climate crises, rising social inequalities, geopolitical instability, and profound technological transformations require a critical reassessment of traditional development models, primarily based on linear economic growth and the intensive use of natural resources. In this context, the need to develop alternative paradigms within an interdisciplinary perspective emerges.

The 2030 Agenda for Sustainable Development, adopted by the United Nations in 2015, represents the main global strategic framework. Through the 17 Sustainable Development Goals (SDGs), it proposes a development model geared towards balancing the economic dimension, social justice/cohesion, and environmental protection, promoting a systemic approach to current global challenges. Sustainability is no longer interpreted solely in an environmental context, but as a cross-cutting principle involving governance, technological innovation, education, health, human rights, and social inclusion.

In this scenario, innovation plays a crucial role. It is not limited to the technical-scientific dimension, but encompasses organizational, cultural, and social processes capable of generating shared value and improving collective well-being. Sustainable innovation, in fact, encompasses processes, products, and organizational models aimed at generating positive environmental and social impacts. At the same time, social innovation, defined as innovative practices aimed at solving collective problems through community engagement and cooperation between public and private actors, is gaining increasing importance. Digital innovation, accelerated by the spread of artificial intelligence, big data, and information technologies, is also a central element of contemporary transformations. However, it also

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presents significant ethical and social challenges, such as the risk of digital exclusion, the concentration of information power, and issues related to privacy and algorithmic governance.

For these reasons, innovation cannot be considered neutral, but must be guided by ethical and sustainable principles. Scientific and technological research is therefore called upon to address issues of social responsibility, distributive justice, and environmental impact.

The papers in this issue of the Review of Studies on Sustainability demonstrate this conceptual evolution, offering different yet converging perspectives toward a common goal: building more equitable, resilient development models oriented toward collective well-being.

The contributions present a constant dialogue between sustainability and innovation. In the economic and political spheres, the role of public policies, energy efficiency, and carbon pricing instruments in promoting growth models compatible with the European sustainable development goals emerges. At the same time, the focus on governance and institutional effectiveness highlights how the quality of public decisions is essential for addressing ecological and social transitions.

Technology, and artificial intelligence in particular, occupies a central place in the proposed reflections. From beekeeping to the management of healthcare organizations, AI is interpreted not only as a tool for operational efficiency, but as a strategic lever for generating sustainability, supporting more informed decision-making processes, and improving the ability to adapt to climate and organizational changes. However, the studies also emphasize the need for responsible governance of innovation, based on transparency, accountability, and the valorization of human capital.

Another thematic focus concerns the relationship between sport, education, and social inclusion. Outdoor sports activities, sustainable development programs in youth tennis, and health promotion practices through sport demonstrate how movement and physical activity can become tools for education, relationships, and physical and mental well-being. In these experiences, sustainability takes on the meaning of harmonious personal growth, inclusion, and the valorization of differences.

Finally, the social dimension of sustainability takes on particular importance, explored through new metrics for evaluating human capital and corporate welfare. The introduction of innovative indicators related to parenting and personal well-being demonstrates the growing focus on organizational models capable of combining economic performance and social responsibility.

Taken together, these works paint a picture of dynamic and multidimensional sustainability, requiring integrated approaches, transversal

skills, and ongoing collaboration between research, institutions, and civil society. The variety of topics addressed, therefore, does not represent fragmentation, but rather confirmation that contemporary challenges can only be understood and addressed through an interdisciplinary perspective.

This issue therefore aims to be a space for scientific and cultural exchange, in which different perspectives contribute to outlining new trajectories of sustainable development, placing people, responsible innovation, and the future of communities at the center.

Climate Change and the Role of Using Artificial Intelligence Applications in Apiculture

by *Özge Özden*[*], *Salih Gücel*[°], *Muhammed Adeel*[§], *Fadi Al-Turjman*[**], *Gennaro Di Prisco*[♦]

Abstract
Wild and commercially significant plants are pollinated by honeybees. Currently, apiculture is suffering from the negative consequences of climate change, including extreme weather conditions and increasing temperature averages. Climate change can affect floral sources of honey bees, increase the frequency of parasites and diseases, and interfere with pollination cycles; thus, climate change poses a serious danger to apiculture and consequently beekeeping industry and global food production. Utilising cutting-edge technologies like artificial intelligence (AI) applications are crucial for reducing the negative effects of climate change on honey production and bee populations. AI can play a crucial role in apiculture by helping beekeepers to monitor and manage their hives more efficiently. This study employed a review-based approach to determine how AI can be employed in the beekeeping sector. The results suggests that combination of AI, ML and IoT can be used to evaluate environmental data, such as weather patterns, flowering seasons and satellite images interpretation. That can optimise beekeeping methods by forecasting the ideal periods for hive inspections, honey harvesting, and other tasks. This can increase the overall productivity of the hives and help bee keepers to make better decisions for the sustainability of their apiaries.
Keywords: Climate change, artificial intelligence, machine learning, apiculture, Cyprus.

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1. Introduction

1.1. Background and History of Beekeeping in Cyprus

Cyprus is the third largest island in the Mediterranean sea with a rich history spanning thousands of years, it is a strategically and geopolitically an important island (Şenol, 2021). Many civilizations have lived on Cyprus, including the Lusignans, Venetians, Ottoman Empire, and British Empire (Özsağlam, 2018). In the early Cretaceous, "bee like insects" first appeared in Western Gondwana, which includes Africa and South America. They then spread to other continents (Almeida et al., 2023). In the old time when there was no concept of bee keeping people were hunting wild honey to fulfil their nutritional and medicinal needs. Between 1500 and 1851, modern beekeeping evolved, leading to Langstroth's creation of the movable-frame hive (Eroğlu & Yüksel, 2020). After that in the next two millennia, beekeeping flourished throughout the Mediterranean region as the Egyptians developed advance apiculture by 2450 BCE (Kritsky, 2017).

In addition to its nutritional, medicinal, economic, and ecological advantages, honey bees and their products had historically symbolic meaning in early beliefs and World religions (Crane, 1999). With the passage of time and continuous attempts to increase production efficiency in nations, beekeeping now plays a major role in ecosystem services assurance, including agricultural pollination and human health (Eroğlu & Yüksel, 2020). Cyprus is home to 369 confirmed species of wild bees from six groups belonging the superfamily *Apoidea,* with 21 endemic species (Varnava et al., 2020). Although the taxonomic work is detailed, there is very little information known about the ecology of the native honey bees of Cyprus, *Apis mellifera cypria* (Kandemir et al., 2006).

1.2. Benefits of Beekeeping in Cyprus

Beekeeping offers economic, ecological, nutritional benefits, honey bees do pollination in agricultural crops as well as great possibilities for forest protection and rural development by providing the employment opportunities for people (Sokhai & Mardy, 2024; Teferi, 2018; Chanthayod et al., 2017). Cyprus is Mediterranean islands with diverse floras that attracts honey bees for foraging, which improves the quality of honey, people in rural Cyprus keep bees for household use and sell products related to beekeeping to make money. Some of the products of beekeeping are honey, pollen, bee venom, royal jelly and propolis that provides numerous benefits to human health (Pasupuleti et al., 2017).

Numerous scholars have provided the benefits of beekeeping in many different ways. For example Teferi (2018) stated that beekeeping delivers societal benefits in Ethiopia by alleviating poverty, preserving biodiversity, generating money, employment, and ecological security. Similarly, Qaiser et al., (2013) stated that beekeeping is a profitable business that can create jobs and reduce poverty in rural Pakistan. Additionally, beekeeping training programs have a good impact on the socio-economic condition of rural farmers and youths. In the case of Cyprus, commodity prices are rapidly rising. By keeping bees, residents in rural regions can quickly improve their income levels, allowing them to survive when everything becomes more expensive due to inflation.

The flora of Cyprus is distinctive and wide-ranging, containing significant plant and tree species (Eliades et al., 2018). Cyprus is home to olive varieties, eucalyptus, lavender, citrus and carob all of which boost honey bee productivity, which benefits both the people and the area. This can be an effort to improve honey production by characterize it as Cypriot honey with such unique flavours and taste. As a result, beekeeping practices in Cyprus could be more advantageous.

1.3. Challenges Faced by Honey Bee Colonies

The sustainability of beekeeping is threatened by several issues. Pests and pathogens are major problems, especially wax moths and *Varroa* mites, which can result in large colony losses (Singh & Sharma, 2017). Moreover, serious dangers to honey bee health and productivity are also posed by environmental abiotic stress factors such pesticide use, pollutants, climate change, and harsh weather. The adverse impact of environmental conditions on output and significant colony losses owing to climatic changes and other practices have caused economic challenges for beekeeping in recent years (Köseoğlu et al., 2021). In fact, Cyprus has seen severe trends in drought and water scarcity (Myronidis et al., 2018). The agriculture sector in Cyprus is heavily reliant on rains, and changes in rain patterns have had a significant impact on crop production. As a result of the reduced availability of water, wild plants that are useful for beekeeping are less likely to develop which create stress for the honey bees because they are unable to get pollens and nectar.

Honey bee colonies face several key challenges that are shown in Figure 1. Guyo & Legesse, (n.d.) explained that drought, illnesses, pests, chemical toxicity, and a lack of equipment are Ethiopia's biggest beekeeping issues. While, the Kangra district's beekeepers struggle since they don't know enough about bee management technologies and associated skills (Kumar &

Kundal, 2016). Similarly, low quality management, colony movement, chemical toxicity, and insufficient research are the primary issues that are faced by beekeepers in Nepal (Aryal et al., 2015) and Bangladesh (Jahan et al., 2021). Cyprus also lacks with the technological information and management's skills required for beekeeping, more technological innovation, research and government support is required to make the beekeeping sector sustainable and successful.

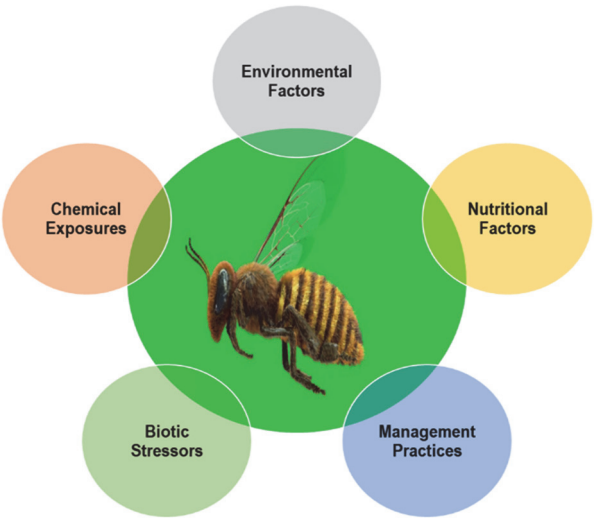

Figure 1. - Challenges Faced by the Bee Colonies
*Note: Created by authors.

1.4. Technology in Beekeeping

Recent technological developments have a big impact on apiculture by providing solutions to a number of problems. Beekeepers are able to manage apiaries more effectively due to remote monitoring devices that use sensors and communication technologies. An advance concept related to beekeeping is precision apiculture, a potential method for managing bee colonies which is centred on tracking individual colonies to maximize productivity and resource consumption (Zacepins et al., 2012). Latest technologies are designed to assist beekeepers by offering real-time data on the health and behaviour of colonies, especially during crucial times like the winter and summer and make decision in advance to potential negative outcome (Stalidzans, 2012). The majority of hives are located on farms that are inaccessible and remote from cities. Therefore, acoustic and optical sensors

are among the many sensing technologies that are being used to keep an eye on important variables including temperature, humidity, and hive weight (Anuar et al., 2023).

To identify and stop significant deviations, an autonomous Internet of Things (IoT) - based beekeeping systems are used remotely to monitor hive conditions (Zabasta et al., 2019). Similarly, (IoT)-based system for wide and long-term bee colony monitoring may identify a variety of characteristics and show the activity and expansion of honey bee colonies (Hong et al., 2020). One of the most common problems for beekeeping face globally is varroa mites, which destroy colonies all over the world due their feeding activity on honey bee larvae and adults, that cause immune suppression and pathogens transmission, mainly viruses. Also, they are difficult to observe being small and life cycle adapted to the honey bee developing stages. Varroa mites cause a significant number of colonies to disappear each year in Cyprus. Therefore, Real-time *Varroa* mite detection in beehives is possible by using an IoT-based edge computing solution that incorporates machine learning (Mrozek et al., 2021). Moreover, applications of nanotechnology have been identified in many areas of beekeeping, such as disease prevention, tools, feeding, and pollination (Abou-Shaara et al., 2020).

To date, AI being used more and more to solve problems in beekeeping, where related tools can help with hive management, health monitoring, disease and pest detection, and adjusting to the effects of climate change on apiculture (Astuti et al., 2024a). One of the biggest threats to beekeepers in Cyprus is hornets, which attack and destroy entire colonies.

Different insect groups, such as honey bee (workers and drones), hornets, and bumblebees, can be automatically identified from photos using deep learning and computer vision (Spiesman et al., 2021). Also, the application of AI-based audio monitoring systems can be used to analyse the sound and frequency within and between the hives (Thu et al., 2020). There are several types of advance technologies which are shown in Figure 2.

Figure 2 - Useful Technologies in Bee Keeping
*Note: Created by authors.

These technologies help beekeepers in the management of their hives globally. The beekeepers of Cyprus are still using the old methods for beekeeping; there is an urgent need to provide information to beekeepers about the new advanced technologies like IoT, machine learning and Ai that can help them to manage their colonies in a better way.

2. Materials and Methods

The material and method section involve 25 recent research articles from various Countries using keywords such as “smart bee keeping,” “climate change,” “artificial intelligence,” from various data sources like Google Scholar, Science Direct, and Springer Link. Relevant articles were reviewed in a comprehensive manner to produce results and discussions. Reviewed research articles are shown in the Table 1.

Table 1 - List of Research Articles Reviewed

No:	Title	Country	Citation
1.	“Predicting internal conditions of beehives using precision beekeeping”	Spain	(Robustillo et al., 2022)
2.	“Modeling bee hive dynamics: Assessing colony health using hive weight and environmental parameters”	Switzerland	(Degenfellner & Templ, 2024)
3.	“Beekeeping in Europe facing climate change: A mixed methods study on perceived impacts and the need to adapt according to stakeholders and beekeepers”	Denmark	(Van Espen et al., 2023)
4.	“Climate change will reduce the potential distribution ranges of Colombia’s most valuable pollinators”	USA	(Gonzalez et al., 2021)
5.	“Heat stress survival and thermal tolerance of Australian stingless bees”	Australia	(Nacko et al., 2023)

No:	Title	Country	Citation
6.	"A Brazilian native bee (Tetragonisca angustula) dataset for computer vision"	Brazil	(Leocádio et al., 2024)
7.	"HiveLink – IoT based smart bee hive monitoring system"	India	(Dsouza & Hegde, 2023)
8.	"Advancing beekeeping: IoT and Tiny ML for queen bee monitoring using audio signals"	Italy	(De Simone et al., 2024)
9.	"Digital transformation in beekeeping to carrying beehives into the future"	Turkey	(Burma, 2023)
10.	"European beekeepers' interest in digital monitoring technology adoption for improved beehive management"	Belgium	(Verbeke et al., 2024)
11.	"IoT embedded smart monitoring system with edge machine learning for beehive management"	Romania	(Doinea et al., 2024)
12.	"Honey production and climate change: beekeepers' perceptions, farm adaptation strategies, and information needs"	USA	(Landaverde et al., 2023)
13.	"Environmental threats to beekeeping in the Western Balkan countries - beekeepers' perceptions"	Serbia	(Šarić et al., 2023)
14.	"Climate change impacts on honeybee spread and activity: A scientific review"	Egypt	(Ali et al., 2023)
15.	"A smart beekeeping platform based on remote sensing and artificial intelligence"	Cyprus	(Grammalidis et al., 2023)
16.	"Design and development of energy efficient algorithm for smart beekeeping device to device communication based on data aggregation techniques"	Rwanda	(Ntawuzumunsi et al., 2023)

No:	Title	Country	Citation
17.	"Beekeeping opportunities, challenges and technology adoption in Gedeo Zone, Southern Ethiopia"	Ethiopia	(Delena & Kayamo, 2024)
18.	"The use of products with a monitoring system for remote bee detection in beekeeping in Czechia"	Czechia	(Kaňovská, 2024)
19.	"Buzzing with intelligence: current issues in apiculture and the role of artificial intelligence (AI) to tackle it"	Hungry	(Astuti et al., 2024b)
20.	"Image recognition using convolutional neural networks for classification of honey bee subspecies"	Italy	(De Nart et al., 2022)
21.	"IoT based smart beekeeping monitoring system for beekeepers in India"	India	(Pandimurugan et al., 2021)
22.	"Adoption and impacts of improved beehive technologies in the miombo woodland of Tanzania"	Tanzania	(Kuboja et al., 2021)
23.	"Toward an intelligent and efficient beehive: A survey of precision beekeeping systems and services"	France	(Hadjur et al., 2022)
24.	"Utilizing IoT technologies to improve beekeeping through remote hive monitoring"	India	(Pal et al., 2022)
25.	"Application of the Internet of Things in precision beekeeping in Latvia."	Latvia	(Zacepins et al., 2022)

3. Results and Discussions

By carefully reviewing the proposed bibliography, several key insights emerged regarding the main stress factors affecting honey bees. It is clear

that, with the aid of new technologies, innovative strategies are necessary for effective management, particularly in proactively safeguarding bee colonies to prevent issues that could have serious economic implications.

The beekeeping sector is facing challenges worldwide, which is also affecting the agricultural pollination because the bees are the main source of pollination. Climate change is a serious threat to the beekeeping industry. According to study, climate change is causing a shift in the blooming of flowers, change in the weather pattern, and an increase in the temperature, all of which are affecting the bee colonies (Ali et al., 2023; Gonzalez et al., 2021). For example, a research was conducted on the Australian stingless bee and they revealed that there is decline in the heat tolerance and heat stress survival which means that there are serious effects of increasing temperature on bees health (Nacko et al., 2023). Similarly, according to climatic estimations the potential global distribution patterns of important pollinators would decrease, which will increase the loss of biodiversity and limiting agricultural production (Gonzalez et al., 2021).

Furthermore, honey bee colonies are facing challenges like decrease in available food, pests like hornets and disease in addition to the challenges related to the environment. Infections caused by fungus, bacterial diseases and varroa mites are causing the colony loses in the World and posing a significant financial burden on bee keepers (Hadjur et al., 2022). Beekeepers in the Western Balkin countries are facing serious problems due to environmental hazards including pesticide exposure and destruction of habitat (Šarić et al., 2023). Similarly, the beekeepers of Cyprus are also facing challenges related to climate change specially changes in the rain pattern. Innovative technologies are required to help beekeepers for the better management of their hives as a result of these challenges.

3.1. Role of (IoT, AI and ML) in Beekeeping

The Internet of things, machine learning, and artificial intelligence all affect smart beekeeping. They offer improved solutions for problems like climate change. These tools facilitate effective hive management, predictive modelling, and real time monitoring, which all contribute to the effectiveness of apiculture.

3.1.1. Real Time Monitoring of Bee Hives

With the help of internet of things (IoT) we can monitor the hive parameters like temperature, humidity, and weight of the hives remotely through internet sources. The measurement of these parameters is important

for ensuring the health of the colony and to identify any threat to the colony on time. According to the studies the IoT based hives allows beekeepers to monitor their hive remotely from the far distances and allow them to take actions ad prevent their colony losses (Dsouza & Hegde, 2023; Pal et al., 2022). These systems have enhanced the hive conditions and facilitated the beekeepers of Latvia for the better management of their bee colonies (Zacepins et al., 2022).

3.1.2. Machine Learning for Predictions

The uses of machine learning algorithms forecast hive dynamics and identify trends that indicate possible dangers. For example, the predictive models that evaluate environmental factors like (temperature, humidity, rainfall) and hive weight have been created to evaluate colony health, giving beekeepers practical suggestions on how to keep colonies safe from collapsing (Degenfellner & Templ, 2024). To further improve the accuracy of apiculture management, machine learning (ML) techniques such as convolutional neural networks (CNNs) have been used for image identification to monitor hive activity and categorize honeybee subspecies (De Nart et al., 2022).

3.1.3. Mitigation of Challenges Caused by Climate Change and Diseases

Artificial intelligence powered solutions are essential for responding, how climate change is affecting apiculture. For instance, smart system that combine AI algorithms and remote sensing give beekeeper's information on environmental factors like temperature variations, humidity and the availability of flowering plants, allowing them to employ adaptive strategies (Grammalidis et al., 2023). By using this Ai based algorithms Cypriot beekeepers can also get information for the availability of nearby foraging places. As beekeepers express the need for solutions to minimize climate-related challenges and protect colony health, research conducted in Europe emphasizes the importance of implementing these types of technologies in bee keeping sector (Van Espen et al., 2023).

Improved disease diagnosis and prevention in honeybee colonies is another benefit of AI and IoT system. Tiny ML and IoT-powered audio signal analysis has been used to track queen bee activity and identify early indicators of hive stress or diseases (De Simone et al., 2024). Cypriot beekeepers can prevent colony losses and increase overall sustainability by pro-actively addressing any health risks by using such devices.

3.2. Benefits of Using Technology in Beekeeping

For beekeepers, the use of artificial intelligence (AI), internet of things (IoT), and machine learning (ML) technologies in apiculture have many advantages. These tools improve the sustainability of beekeeping operations, decrease labor related tasks, and improve decision-making. For example the algorithms that use less energy for IoT communication reduce the environmental impact of precision beekeeping systems, and remote sensing platforms enable beekeepers to effectively manage their hives (Ntawuzumunsi et al., 2023). Furthermore, according to studies from Ethiopia and other developing nations, implementing technology in beekeeping could deal with ecological and economic issues also technology-driven solutions can help small beekeepers by lowering costs, increasing output and encouraging sustainable practices (Burma, 2023; Delena & Kayamo, 2024). Another example, of how these technologies support the expansion of the beekeeping industry is the usage of technologies with the monitoring systems for remote hive management in Czechia (Kaňovská, 2024).

3.3. Challenges in the Adoption of Technology

Though the artificial intelligence and IoT have great potential in beekeeping, the implementation of these technologies is still facing difficulties. Main challenges for beekeepers, especially in developing nations, include high initial set up costs., lack of technical knowledge, and restricted access to advance technologies (Astuti et al., 2024b). Similarly, in Tanzania adopting better beehive technologies can boost bee keeper's income, however this depends on a number of factors like age, education, and access to loans and extension services (Kuboja et al., 2021). Cyprus is also facing similar challenges to adopt the modern technologies that can help beekeepers to manage their hives more efficiently. Furthermore, to guarantee the capacity and long-term sustainability of these technologies concerns about data privacy, system dependability, and energy consumption all of these need to be addressed.

4. Conclusion

The beekeeping business faces complex multifactorial challenges, including diseases, environmental stressors, and climate change, which threaten the sustainability of honeybee populations and their vital role in

global agriculture. These issues have been solved by AI, IoT, and ML technologies, which enable real-time monitoring, predictive modelling, and adaptive hive management. While there are many benefits to implementing these technologies, their widespread adoption depends on addressing obstacles like affordability and accessibility. Employing these innovations to ensure the resilience and productivity of honeybee colonies can help beekeepers support sustainable apiculture and ecosystem health.

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Outdoor Sport-based activities and Educational Sustainability: Learning Processes, Social Relationships, and Psychophysical Well-Being

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Abstract
Outdoor sport-based activities can promote sustainable education and active learning in primary schools, supporting motor and cognitive development, participation, and well-being. However, evidence is limited on the role of low-specialization, adaptable outdoor activities in learning, relationships, and perceived well-being. This study examined a year-long outdoor intervention based on bocce in a natural school setting in Southern Italy. Participants were 20 children aged 9-10, including two with intellectual disabilities. Data were collected through structured and semi-structured observations (1-3 checklist, teacher notes) and repeated student questionnaires. Changes across baseline, midpoint, and follow-up were analyzed in learning processes, inclusion, socio-relational benefits, and well-being/motivation. Results showed progressive improvements in all dimensions, with early gains in learning and motivation, stable high inclusion, and gradual socio-relational growth. Bocce appears feasible, sustainable, and inclusive. Further studies with larger samples and comparative designs are needed.
Keywords: Outdoor Education; Inclusive Education; Sport and Physical activity.

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Introduction

Outdoor education is now recognized as a pedagogical approach capable of enhancing learning through direct experience and interaction with the external environment (Abdullah et al., 2018). In this perspective, the open space is not just an alternative place to the classroom. It becomes an

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educational context that stimulates curiosity, attention and involvement (Becker et al., 2017). Learning, in fact, is consolidated even when students observe, experiment and deal with real situations, often less predictable than in formal contexts. This type of experience can support the integrated development of physical, cognitive, social and emotional skills, making educational processes more complete and meaningful (Quibell et al., 2017).

The outdoor environment requires adaptation, quick decisions and the ability to orient oneself in space. Students are confronted with concrete variables, such as distances, obstacles, surfaces and action times. In this way, learning becomes situated, i.e. linked to the context in which it takes place. Body and mind work together. Relationships also play a central role, because many activities take place in groups and involve discussion, cooperation and management of social dynamics. This approach allows you to develop deeper skills, because they are not limited to theory but are built in experience (Remmen, & Iversen, 2023).

In this context, outdoor sport-based activities are placed, understood as structured motor activities inspired by sports disciplines, carried out in outdoor contexts and oriented towards educational and inclusive purposes, rather than competitive objectives (Susanto et al., 2024). In primary school, these activities represent a concrete resource (Newman et al., 2012). They allow you to integrate movement, learning and participation. It's not just about “playing sports”. It is a matter of living an educational experience in which the motor gesture also becomes an opportunity for relationships, behavior regulation and the construction of shared meanings (Helleman et al., 2023).

When outdoor sports activity is proposed intentionally, the benefits are not limited to the development of basic skills such as balance, coordination and spatial-temporal perception. An improvement in social skills may also emerge. Students learn to respect rules and turns, to collaborate and to manage confrontation with others. In these contexts, participation tends to increase because the environment is less rigid and more stimulating than in closed space. This can foster a more inclusive and motivating educational climate, in which each student finds a role and a possibility of expression (Armour, & Sandford, 2013).

A further important element concerns psychophysical well-being. Outdoor experiences can reduce tension and stress, supporting a more positive mood and a greater willingness to learn (Deschamps et al., 2022). Well-being is not a marginal aspect, but a factor that influences attention, motivation and the quality of interactions. For this reason, the emotional and relational dimension must be considered an integral part of educational

processes, especially in primary school, where the sense of security and belonging directly affects involvement (Mosca et al., 2024).

Outdoor sport-based activities can also be read as tools consistent with educational sustainability. Educating in a sustainable way means building contexts that promote accessibility, participation and inclusion. It also means enhancing the environment and the territory as educational resources (Walshe et al., 2023). The outdoor experience, in this sense, is not just about "taking lessons outside". It concerns the idea of school as a living, open space capable of connecting learning, relationships and responsibilities. Outdoor motor activities of a sporting nature can strengthen this vision, because they promote cooperative practices and a sense of belonging, transforming the experience into an opportunity for individual and collective growth (Kiviranta et al., 2024).

In light of these considerations, the present study analyzes a sport-based outdoor activity in primary school based on the game of Bocce. The choice of Bocce derives from the characteristics of discipline, as it is able to promote discipline, flexibility and adaptability. It does not require complex technical skills, but stimulates precision, coordination and control of gesture (Toohill, & Entwistle, 1999). At the same time, it requires planning and reading the situation, because every launch involves a decision. Bocce also fosters ongoing peer interactions. Children observe, discuss, wait for their turn and share strategies. This makes the experience particularly suitable for supporting participation and social relationships (Erol et al., 2024).

Inclusion is also a central aspect. The game of Bocce allows concrete adaptations, both in the rules and in the methods of execution. This allows for more equal participation, even in the presence of specific educational needs or motor difficulties (Andajani et al., 2023). The group, in these conditions, is not just a set of individuals playing, but becomes a context in which cooperation, mutual respect and recognition of differences are experienced. In this sense, Bocce can represent an effective example of outdoor motor activity of a sporting nature aimed at building well-being and sociality, as well as the development of skills.

Despite the growing interest in outdoor education and experiential learning, the literature still shows limited attention to the specific effects of outdoor sport-based activities in primary school, especially in relation to the quality of social relationships and perceived psychophysical well-being. In addition, the contributions of activities with low technical specialization but high organizational flexibility, such as bocce, in educational paths oriented towards participation and inclusion are still little explored. Starting from this gap, the present study aims to analyze the educational potential of an outdoor sport-based activity in primary school, considering the game of bocce as a

case study. In particular, the learning processes activated by the experience (both on a motor and strategic level), the level of inclusion and participation of the class group, the socio-relational benefits that emerged in the dynamics between peers and the wellbeing and motivation perceived by the students during the course will be evaluated.

Methods

Study design

The study was conducted through an observational longitudinal design, implemented in a school context in southern Italy. The project was integrated into the normal activities of the primary school and aimed to explore the educational potential of outdoor sport-based activities, in relation to learning processes, the quality of social relationships and the psychophysical well-being perceived by the pupils.

The course developed over an entire school year, with two meetings a week lasting about 60 minutes each. The activities took place mainly in an outdoor environment, using both the outdoor spaces of the school and, at sometimes, an outdoor bowling alley. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Prior to the start of the project, parents/legal guardians received clear information on the purposes and methods of operation and provided written informed consent to participate.

Participants

20 pupils (aged between 9 and 10) belonging to a primary school class located in Southern Italy participated in the study. The class group was heterogeneous in terms of individual characteristics, levels of ability and methods of participation in school activities. Within the sample there were also two pupils with intellectual disabilities, inserted in the classroom context with the support of the support teacher.

Pupils who met the following criteria were included in the study: belonging to the class involved in the project; age between 9 and 10 years; participation in normal school activities; possibility of carrying out motor activities in an outdoor environment in safe conditions, also with any didactic adaptations or educational supports. Pupils with disabilities were also included, as the aim of the study was to observe participation and relational

dynamics in an authentically inclusive context. Pupils who, during the period of the intervention, had medical conditions or temporary limitations such as to prevent participation in outdoor activities in a safe way (e.g. injuries or specific indications of unfitness) were excluded. Cases of prolonged absence that did not allow continuous participation in the phases envisaged by the project were also excluded.

Procedures

The study procedures have been developed to ensure a realistic and sustainable implementation in the school context, without interrupting the classroom routine. The activities were carried out in an outdoor environment, during moments dedicated to the motor and educational proposals provided for in the program. The class participated as a natural group, avoiding artificial subdivisions and maintaining an authentic context.

The intervention was conducted through a collaboration between three key figures: the curriculum teacher, the support teacher and an instructor from the Italian Bocce Federation. This organization has made it possible to integrate educational skills and technical-sports skills, keeping the activity accessible and consistent with the needs of the class group. The presence of the support teacher also favored the continuous participation of pupils with intellectual disabilities, especially in moments of greater complexity.

During the course of the activities, particular attention was paid to safety, space management and clarity of deliveries. Proposals were presented with simple indications, often accompanied by practical demonstrations, to facilitate understanding and reduce the risk of exclusion. When necessary, adaptations were introduced in the throwing distance, the duration of the tasks or the mode of execution, keeping the educational objective of the experience unchanged.

The procedures provided for a gradual progression, with a controlled increase in difficulty and with recurring moments of feedback. After each session, a few minutes were left for a brief collective restitution, useful for bringing out strategies, difficulties and ways of collaborating. This moment, simple but constant, helped the children to give meaning to the experience and to recognize the value of group work.

Sport-based intervention

The intervention was designed as a path of outdoor sport-based activities based on the game of bowls, selected for its simplicity, its flexibility and the possibility of involving all pupils in an active way. The activities were built

to progressively develop motor and cognitive skills, but also social skills related to participation, cooperation and respect for rules. The work was organised in three phases: an initial phase, an intermediate phase and a consolidation phase. This scan allowed the children to acquire skills gradually. It also allowed us to observe how participation, social interactions and cooperation skills changed over time.

Phase 1 – Startup and familiarization: getting to know the game and the space

In this first phase, the main goal was to make the children feel "comfortable" with the activity. A lot of work has been done on discovery and mutual listening.

The exercise plan included:

1. Exploration of the material: grip of the ball, posture, balance and control of the gesture, with guided free trials.
2. Short-range precision throws: Throws towards a large target area, with attention to direction and not force.
3. Simplified paths: Throws with small constraints (e.g. "from behind a line" or "with a firm step") to strengthen coordination.
4. Rotation and basic rules: mini-games with short times, to introduce respect for the turn, waiting and error management.

At this stage, the children began to understand that play is not just about throwing. It also matters how you are in the group. What matters is the way you speak and listen.

Phase 2 – Development and increasing complexity: strategies and cooperation

In the intermediate phase, the activity has become more challenging. The children began to reason before acting and learned to confront each other in a more intentional way.

The exercise plan included:

1. Medium-distance throws with a specific objective: to bring the ball closer to the cue ball with greater precision, working on trajectory and intensity.
2. Problem solving tasks: small game situations in which the group had to choose the strategy ("is it better to approach or move the opponent?").
3. Pair play: two children per team with alternating roles, so as to stimulate collaboration and shared decision-making.
4. Progressive constraints: for example, changing the launch point, introducing natural obstacles or demarcating play areas to increase the need for control.

Pupils with disabilities also participated fully, thanks to simple but effective adaptations, such as shorter distances, longer times or support in understanding the assignments. In the classroom this makes the difference. And his teammates perceive it immediately.

Phase 3 – Consolidation and transfer: new contexts and autonomy

The last phase was designed to consolidate what has been learned and verify the ability to adapt to a more structured environment. The activities also took place in an outdoor bowling alley, offering a different context than school spaces.

The exercise plan included:

1. Simplified matches with comprehensive rules: with defined times, scoring and team rotation.
2. Co-op challenges: Group goals (e.g., achieving a number of "useful" launches without focusing only on the final result).
3. Role rotation: children called upon to manage small organizational tasks (scoring, recalling the turn, checking the lines).
4. Moments of final reflection: short guided discussion on what worked, what was difficult and how the group collaborated.

In this phase, the relational dimension emerged more clearly. Some children showed more autonomy. Others needed support. In both cases, the game functioned as a real educational space, in which participation and well-being could be observed in a concrete way.

Measures

To ensure a systematic survey consistent with the objectives of the study, data collection was conducted through structured and semi-structured observation tools, selected to be sustainable in the school context and understandable for children. The focus was not only on participation and inclusive dynamics, but also on the learning processes activated by outdoor sport-based activities, as well as motivation, perceived well-being and the quality of peer relationships.

The measures made it possible to monitor four main dimensions: learning processes (detected through the observational rubric), inclusion (real participation and quality of integration in the group), socio-relational benefits (cooperation, functional communication, respect for turns and shared rules) and well-being/motivation (enthusiasm, persistence and

subjective perception of experience), in line with the principles of inclusive education and learning in outdoor context (Kelly et al., 2022).

The observations were collected during the sessions and used to describe the trend of the variables over time, while maintaining attention to individual differences and group dynamics. The information from the rubric, check-list and diary were read in an integrated way, so as to obtain a more complete understanding of the processes activated by outdoor sport-based activities, while the questionnaires provided useful support to interpret the experience from the students' point of view.

Observational Learning Rubric

Learning was detected through a qualitative observational rubric, compiled by the adults involved in the activities (curriculum teacher, support teacher and federal instructor). The rubric has been constructed to document, in a descriptive and non-numerical way, the progressive changes in the skills developed during the game of bowls. Each dimension was evaluated through three interpretative levels (Emerging, Developing, Consolidated), based on observable evidence shared among observers. In particular, the column considered: the understanding of rules and instructions (e.g. ability to respect turns and procedures without continuous reminders), motor control of the gesture (stability, intentionality of the throw, force adjustment), the use of game strategies (conscious choice of the action, planning, adaptation after a mistake) and autonomy in the task (ability to act with increasing independence and to keep attention on the goal). This tool made it possible to describe learning as a process, observing how children gradually moved from a more spontaneous execution to a more conscious and regulated behavior.

Observational behavioral checklist

Alongside the learning rubric, an observational check-list, compiled by the adults involved in the project, was used to monitor behavioral and relational aspects that emerged during the sessions. The check-list was organized into observable indicators related to: peer cooperation (mutual support, spontaneous help, shared strategies), participation and involvement (attention to the task, initiative, continuity in the activity), respect for rules and shifts (waiting for one's turn, compliance with deliveries, self-control) and inclusive dynamics (integration into the group, absence of exclusion, participation of pupils with disabilities). To make the observational process

clearer and more consistent, the indicators were accompanied by essential descriptors that helped to uniformly recognize relevant behaviors.

Teacher's Observational Diary

An observational diary compiled by the teacher was also used, aimed at collecting significant episodes and situations that emerged during the activities that required a more narrative description. The diary made it possible to record moments of spontaneous collaboration, relational difficulties, peer inclusion strategies, emotional reactions and changes in the way the children approached play. This qualitative material was particularly useful for interpreting the observational data, because it returned the "how" and "why" of some dynamics that are not always visible through more structured instruments.

Questionnaire for pupils

To integrate the observation of adults with the point of view of children, a short questionnaire with simple and age-appropriate language was administered. The tool detected the subjective perception of the experience in terms of fun and motivation, perception of participation, perception of inclusion in the group and willingness to repeat the activity. The questionnaire was administered at three times of the school year: at the beginning (T0), at the middle of the course (T1) and at the end (T2), so as to capture any changes in the perception of the experience over time.

Statistical analysis

The data were analyzed with a descriptive and inferential approach, with the aim of exploring the trend of the observed variables over time and verifying any changes between the three moments of detection (T0, T1, T2). In a first phase, descriptive statistics were calculated, reporting frequencies and percentages of the observed levels (1-3) and, when appropriate, averages of the scores to summarize the trend of the different dimensions considered. This choice was appropriate to the nature of the data, mainly ordinal, and to the small number of the sample. Given the repeated measures structure, the Friedman test was used to evaluate the differences between the three time-points in the variables detected through checklists and questionnaires. When the overall analysis was significant, post-hoc pairwise comparisons (T0 vs T1, T1 vs T2, T0 vs T2) were performed by Wilcoxon paired sample tests,

applying a correction for multiple comparisons (Bonferroni) in order to reduce the risk of type I error. For each comparison, the size of the effect was also estimated, calculating the r index ($r = Z/\sqrt{N}$), so as to interpret the observed changes not only in terms of statistical significance but also in terms of practical relevance. In relation to the dimensions most related to participation and inclusion, a specific descriptive analysis was also conducted for pupils with disabilities, useful for observing the evolution of the levels of involvement and integration in the group; Given the small number of this subgroup, these results have been interpreted with caution and presented mainly as a descriptive support. The qualitative information collected through observational diary was used to integrate and contextualize the quantitative results, through a thematic reading oriented to the identification of recurring episodes related to cooperation, inclusive dynamics, play strategies and emotional well-being. The integration between observational data and pupils' perceptions allowed a more complete reading of the educational experience, avoiding interpretations based on a single indicator. The level of statistical significance was set at $p < .05$ and analyses were conducted using SPSS statistical software (version 30.0 (2024) - International Business Machines Corporation, Armonk, New York (USA).

Results

The four dimensions were assessed at three time points (T0 = initiation, T1 = intermediate, T2 = consolidation). Scores generally increased over time. By the final phase, higher ratings were more frequent, and lower ratings were already less common at T1. Differences across the three measurements were tested with the Friedman test. Where needed, pairwise comparisons were explored through Wilcoxon tests, applying a Bonferroni correction.

Learning processes showed a significant change across time. The strongest shift appeared early, between T0 and T1, while the consolidation phase mainly reflected stability rather than further growth. Pairwise results were most evident when baseline was used as the reference. Inclusion displayed the same overall structure: a significant time effect, clearer improvements compared with T0, and smaller changes between T1 and T2. For well-being and motivation, the pattern was again consistent, with a significant increase already visible at T1 and then maintained through consolidation. Socio-relational benefits moved upward as well, but the change did not reach statistical significance, and pairwise comparisons did not identify reliable differences. This suggests a slower and less stable development of peer dynamics within the class group. Full statistical details are reported in Table 1.

Table 1 shows significant differences between the three survey points for learning processes, inclusion and well-being/motivation, showing a progressive improvement along the way, with more marked effects between T0 and T2. Post-hoc comparisons indicate that the most consistent changes are concentrated mainly in the first half of the intervention (T0–T1), with a subsequent stabilization. The socio-relational benefits show a positive trend, but do not reach statistical significance, suggesting a more gradual evolution of relational dynamics in the class group.

Table 1 - Nonparametric test results for repeated measurements

Variable	Friedman $\chi^2(2)$	p	Post-hoc Wilcoxon T0 vs T1 (Z; p; r)	Post-hoc Wilcoxon T1 vs T2 (Z; p; r)	Post-hoc Wilcoxon T0 vs T2 (Z; p; r)
Learning processes	13.84	.001	− 2.78; .005; .44	− 1.92; .055; .30	− 3.32; .001; .53
Inclusion	10.26	.006	− 2.45; .014; .39	− 1.21; .226; .19	− 2.89; .004; .46
Socio-relational benefits	5.44	.066	− 1.62; .105; .26	− 0.88; .378; .14	− 1.84; .066; .29
Wellbeing and motivation	9.71	.008	− 2.58; .010; .41	− 1.34; .180; .21	− 2.94; .003; .47

Note. T0 = beginning; T1 = intermediate phase; T2 = consolidation. Post-hoc comparisons are reported as Z; p; r, with r = Z/√N. P-values can be interpreted with Bonferroni's correction for multiple comparisons (corrected α = .05/3 = .017).

After examining the overall data, Fig. 1 summarizes the trend of the four dimensions observed in the three moments of the course (T0 = beginning, T1 = intermediate phase, T2 = consolidation), highlighting how the average levels have changed during the school year.

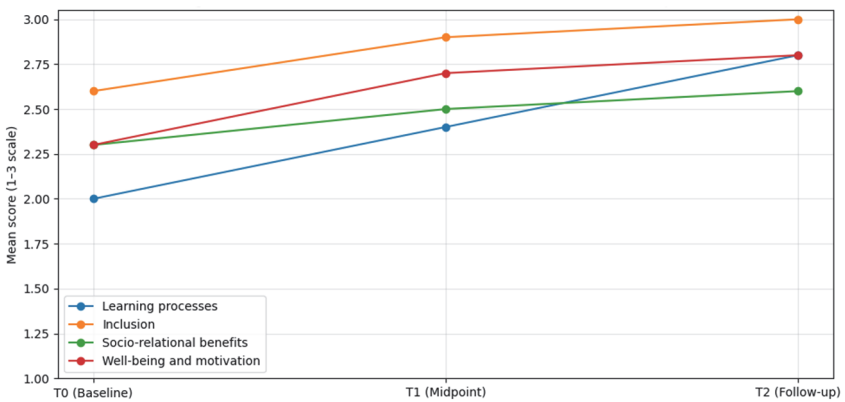

Fig. 1 - Trend of the average scores of the variables observed in the three moments of survey

Fig. 1 shows that all four dimensions improve over time: learning processes, inclusion, socio-relational benefits, and well-being/motivation. Learning processes change the most. From the first to the third measurement point the increase is steady, which is consistent with a gradual consolidation of the skills required by the task and a better handling of the game rules. Inclusion starts high and stays high. By the last phase it is essentially stable at the upper level, confirming that the activity is accessible and that small, heterogeneous groups worked well in practice. Socio-relational benefits follow a different pace. They improve, but more slowly, suggesting that cooperative dynamics and peer interaction quality may need longer exposure before they become fully established. Well-being and motivation rise earlier, already at midpoint, and remain high at follow-up. This indicates positive emotional involvement and participation that becomes more consistent across time. Taken together, the figure supports the idea that integrating outdoor bocce-based activities into the school routine can create a meaningful educational experience, with benefits for learning, inclusion, participation, and relationships among peers.

Discussions

The aim of the present study was to explore the effects of outdoor sport-based activities, based on the game of bowls, in primary school, observing in particular how this experience could affect the learning processes, inclusion, socio-relational benefits and well-being/motivation of pupils over an entire school year. The intent was not only to describe a motor activity in an outdoor environment, but to understand its educational potential as a sustainable practice that can be replicated in the school context.

The results indicate a positive and progressive trend in all dimensions considered. The most evident improvement concerns the learning processes, which increase steadily from T0 to T2. This suggests that, over time, children have not only "played better", but have developed a greater ability to read the situation, respect constraints and rules, and adapt their behavior in a more conscious way. It is a change that appears gradual, but clear. The outdoor environment, with its variables and its small unforeseen events, seems to have favored situated learning, closer to reality and less tied to rigid schemes (Dean, & Gallifa, 2025). In this sense, the game of bocce has proved to be a useful context for training attention, precision, planning and self-control, without transforming the activity into a technical performance for its own sake.

Inclusion also shows a particularly interesting trend. Initial levels are already high and tend to plateau towards the top in the final stage. This suggests that the experience did not "create" inclusion out of thin air, but functioned as an educational space capable of maintaining and strengthening it over time (Di Palma et al., 2025; Natalini, 2025). This is an important aspect, especially because the class group included pupils with intellectual disabilities. In this context, bocce seems to offer a concrete advantage in terms of understandable rules, modular motor engagement and adaptability of the practice that allows simple adjustments without altering the meaning of the game (Montesano et al., 2013). Participation, therefore, does not depend on performance, but on the possibility of being there, of having a turn, of contributing and of being recognized by the group (Pan, & Davis, 2015; Aidar et al., 2022).

The socio-relational benefits increase, but at a slower pace. This is a plausible outcome as social skills do not always grow linearly and often take time to stabilize. Collaborating, managing a conflict, waiting for the turn or accepting the mistake are not skills that are consolidated in a few weeks. They require repetition and trust (Степанюк et al., 2023). In this study, the progressive growth of the higher levels suggests that the group has learned to "stay in the game" in a more mature way, with increasingly functional and cooperative interactions. It is possible that the simple structure of bowls, based on shifts, observation and respect for shared rules, has created the conditions to exercise these skills in a natural way, without forcing.

Another important result concerns well-being and motivation, which increase markedly already in the intermediate phase and then remain at high levels until consolidation. This trend seems to indicate an early effect of the experience, probably linked to the fact that outdoor activity breaks the routine, makes learning more dynamic and allows children to move in a less constrained space than the classroom (Latino et al., 2023). In addition, the playful dimension of the game of bowls may have supported motivation without generating pressure. The children were able to experiment, make mistakes and try again. And this, in primary school, is often a decisive factor in maintaining positive involvement (Köroğlu, 2025).

Read together, the results support the idea that sport-based activities in an outdoor context, if well structured and integrated into teaching, can represent an effective and sustainable educational model. It is not just a matter of “moving” outdoors. The point is that movement becomes an educational language that allows you to learn through experience, to build shared rules and to recognize the group as a resource. In this sense, the choice of an activity with a low technical specialization such as bocce appears consistent with the objective of ensuring accessibility and continuity, preventing the

complexity of the sporting gesture from becoming a barrier to participation (Baan et al., 2023).

Of course, the study has some limitations that must be considered carefully. The sample is small and the absence of a control group does not allow the changes observed to be causally attributed exclusively to the intervention. In addition, the measurements used are based on ordinal scales and observations conducted in a real context, with an inevitable component of interpretation. However, the continuity of the path throughout the school year and the integration between structured tools and descriptive observations represent a strength, because they allow us to grasp changes not as isolated events, but as educational processes that are consolidated over time.

In the future, future research could expand the sample, include a comparison between classes or between different types of outdoor sport-based activities, and use more sensitive tools to detect even more precisely the evolution of social skills and learning. Deepening individual differences, for example related to gender, initial levels of competence, specific educational needs or related to body image (Latino et al., 2019), could also offer useful indications to further personalize the intervention. Despite these aspects, the results obtained suggest that the game of bocce, proposed in a continuous and inclusive way, can represent a concrete resource to promote learning, participation and well-being in primary school, while strengthening the quality of peer relationships.

Conclusion

This study explored the educational potential of outdoor sport-based activities in primary school, using the game of bocce as a structured and inclusive experience developed over an entire school year. The aim was to understand if and how this proposal could support learning processes, participation, the quality of social relationships and the perceived well-being of pupils. The descriptive results show a progressive improvement in all dimensions observed, with a particularly evident increase in learning processes and well-being/motivation, already in the intermediate phase and then consolidated in the final phase. Inclusion has remained at high levels from the beginning and has reached a full stabilization in consolidation, confirming the consistency of the activity with an accessible and participatory approach. The socio-relational benefits, while showing a more gradual evolution, nevertheless highlight a strengthening of cooperative dynamics and peer interactions over time. Overall, experience suggests that

activities with low technical specialization and high organizational flexibility, such as bocce, can represent a sustainable and replicable model for integrating motor learning, relational dimension and well-being in outdoor contexts. Further studies with larger samples, comparative designs and more sensitive assessment tools remain necessary, but the results obtained offer useful indications to enhance outdoor educational practices capable of combining movement, inclusion and quality of the school experience.

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Sustainability in Youth Sport Performance: A Study on Anthropometry and Motor Skills in Women's Tennis

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Abstract
In youth women's tennis, building a performance model requires linking physical traits and motor capacities to competitive progression without harming long-term development. Here, sustainability means guiding training and talent pathways through evidence-based, age-appropriate, and individually tailored criteria, limiting early-specialization bias and weak selection practices. This pilot study explores the anthropometric profile and selected motor indicators of U18 female tennis players to outline preliminary reference trends for a sustainable youth performance framework. An experimental field-based design was used, assessing basic anthropometrics (e.g., height, body mass) and tennis-related motor capacities through a sport-specific test battery. This work represents a first step toward an optimal youth performance model that supports talent identification and long-term athlete development using measurable, context-sensitive parameters. Results may help coaches align performance improvement with sustainable growth.
Keywords: youth tennis, sustainability, anthropometry, motor assessment, performance model.

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Introduction

Performance in tennis can hardly be explained by a single factor. It is built over time through the interaction between physical characteristics, motor skills, technical execution and tactical choices, which must then emerge in

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real race conditions (Brouwers et al., 2012). In youth tennis this picture is even more complex. Athletes are called upon to compete, but they are also in a development phase. In late adolescence, differences in biological maturation, training history and competitive exposure can be significant and often result in different performance profiles even among players in the same category (Kramer et al., 2017).

For this reason, building a performance model in youth tennis should not be understood as a rigid standard. It is more useful to consider it as an interpretative tool: a practical reference to understand which aspects tend to support progression, which indicators can be useful for monitoring development and how physical characteristics relate to the real demands of sport (Kolman et al., 2021). This is especially true in youth women's tennis. During adolescence, in fact, female athletes can go through significant changes in body composition, neuromuscular control and movement mechanics (Latino et al., 2019, 2023). These changes can affect performance, but they also affect the athlete's ability to tolerate progressively higher training loads (Susanto et al., 2024).

This perspective is naturally linked to the theme of sustainability, understood here as the sustainable development of the athlete (Aidar et al., 2022). In practical terms, sustainability means building progression paths compatible with long-term growth, reducing the risk of avoidable injuries and avoiding short-term solutions that can produce immediate results but limit future potential. In youth tennis, early selection processes and strong competitive pressure are frequent, which can make short-term results excessively decisive (Ulbricht et al., 2016). However, early success does not always predict progression in the long run. Athletes who mature earlier may appear to have an advantage in the short term, while "late developers" may need structured support so as not to be excluded too soon. Careful use of physical profiling can help reduce these biases and support more balanced decisions (Deng et al., 2023).

From a performance point of view, tennis is characterized by intermittent high-intensity activity. The race requires repeated acceleration, braking, rapid changes of direction and explosive actions performed in short time windows and repeated over often prolonged match durations. The athlete must initiate the movement quickly, reposition himself efficiently and maintain technical control under conditions of time pressure, fatigue and tactical variability (Girard, & Millet, 2009). On a physiological level, tennis alternates almost maximal actions with partial recoveries, requiring both neuromuscular readiness and the ability to repeat high-quality efforts during the entire match. On the biomechanical level, sport requires rapid force production and effective transfer along the kinetic chain during specific

actions. In practice, it is not enough to possess isolated physical qualities: what matters is how these qualities are expressed in functional motor patterns that support technical-tactical execution (Fernandez-Fernandez et al., 2022).

In this context, anthropometric characteristics have long been considered an important component of tennis performance. They are easy to detect, relatively stable, and often interpreted as structural advantages. Height, in particular, has been widely discussed for its relationship to serve mechanics and the effectiveness of the "first strike". A higher point of impact can promote more advantageous trajectories, with possible benefits on speed, angles and margin above the net. Given the importance of serve and aggressive patterns in modern tennis, it's understandable that coaches pay attention to this variable (Fernandez-Fernandez et al., 2023).

At the same time, the interpretation of anthropometric traits in youth categories requires caution. Late adolescence is still a developmental stage, and maturation can generate temporary differences that may appear as stable advantages. Anthropometry can help explain some performance trends, but it should not be treated as a definitive threshold for predicting future success. A selective approach that is too morphology-centric can become unsustainable, favoring female athletes who mature early and reducing opportunities for those who develop later, with possible consequences on long-term development and talent retention (Parpa et al, 2022).

In addition, anthropometry does not act in isolation. Height interacts with body mass, segmental proportions, and movement efficiency, and these interactions can produce different functional outcomes. Two athletes of similar stature may show different abilities to accelerate, decelerate or maintain balance in open stance situations, and these functional differences may matter more than "raw" anthropometric values. For this reason, anthropometric profiling becomes more informative when it is accompanied by motor and functional indicators (Luna-Villouta et al., 2021).

The evaluation of motor performance provides precisely this functional level. It offers a more direct reading of how the athlete moves, how effectively they produce and absorb force, and how they handle high-intensity repeated actions. In tennis, acceleration can determine whether the athlete reaches the ball in time to hit with control, while the ability to change direction influences court coverage and tactical stability (Rawat et al., 2026). The explosive force of the lower limbs supports rapid starts, braking and re-acceleration, as well as the production of the blow in both stable and unstable conditions. Joint flexibility and mobility can also play a role, allowing you to reach difficult balls, recover from extreme positions, and maintain quality of movement when the intensity increases. These qualities are trainable, so

they are useful not only for describing, but also for planning development (Moreno-Apellaniz et al., 2024).

A further consideration concerns the dependence on the context of tennis performance. Playing surfaces, match pace and tactical preferences can change the relative importance of different physical qualities. Some contexts reward dominance on serve and first-shot play, while others require tolerance to prolonged exchanges and repeated defensive skills. This variability suggests that performance modeling should aim to define useful reference patterns, rather than rigid universal profiles (Pluim et al., 2023).

Despite the extensive literature on anthropometry and physical profiling in tennis, the evidence remains fragmented. Integrated approaches combining anthropometric features and functional motor indicators in the same framework are less frequent, especially in youth women's tennis and late adolescence. The U18 category represents a significant phase because it often coincides with a transition point: training loads increase, competitive demands approach senior levels and selection processes become more intense. At the same time, there is still variability in the state of maturation and in the age of training, which influences both performance outcomes and the interpretation of physical profiles. From an application point of view, many development contexts are based on "field-based" assessments, making it important to produce accessible, repeatable and interpretable data in real coaching environments.

On this basis, the present pilot study intends to contribute to a sustainable performance framework for youth women's tennis by combining basic anthropometric profiling with sport-relevant functional motor indicators. In particular, the study aims to describe the anthropometric profile of U18 players, evaluate some motor performance indicators through field tests, explore the variability within the sample to identify preliminary reference trends and contextualize the results through comparison with federal reference values for the same age group. This preliminary evidence can support data-driven decisions in training planning, monitoring, and long-term athlete development in youth women's tennis.

Materials and methods

Study Design

This research was designed as a pilot, cross-sectional observational study with an exploratory descriptive-comparative approach, aimed at outlining preliminary characteristics of the performance profile in youth women's

tennis. Data collection was conducted through standardized field-based assessments performed in a single testing period (June 2025), in order to obtain an initial snapshot of anthropometric and motor indicators relevant to performance development and to contextualize these findings against federation reference benchmarks for the U18 category. Prior to participation, athletes and their legal guardians received detailed information about the aims and procedures of the study, and written informed consent was obtained. All procedures were carried out in accordance with the ethical principles for research involving human participants and were conducted in line with the Declaration of Helsinki.

Participants

The sample consisted of ten competitive female tennis players (n = 10) aged between 14 and 17 years, recruited through convenience sampling from the local competitive tennis environment. All athletes were actively engaged in systematic tennis training and regular competition at the time of testing. Inclusion criteria were: (i) female sex; (ii) age between 14 and 17 years; (iii) current participation in organized competitive tennis; (iv) regular training involvement during the season; and (v) availability to complete the full assessment protocol within the scheduled testing session. Exclusion criteria were: (i) the presence of acute musculoskeletal injury at the time of testing; (ii) any medical condition or health limitation that could compromise safe participation in maximal or near-maximal physical testing; (iii) recent surgery or rehabilitation interfering with normal training routines; and (iv) inability to complete all required measurements and field tests.

Procedures

Data collection was carried out in June 2025 and followed a standardized protocol to ensure consistency across participants. Testing was conducted in a single assessment period and was organized to minimize fatigue effects and procedural variability. Anthropometric assessment was completed first, followed by the motor evaluation session based on the FITP protocol. All participants were assessed under comparable conditions and completed the full testing sequence during the scheduled session. After data collection, results were recorded and organized for subsequent analysis and comparison with available FITP reference values for U18 athletes of national interest.

Measures

Anthropometric measurements included stature and body mass, obtained using a stadiometer and a digital scale, respectively. Body Mass Index (BMI) was calculated from these measures using standard formulas. Motor performance was assessed through a FITP-based battery aimed at capturing physical qualities relevant to tennis, including linear speed, repeated change-of-direction performance, flexibility of the posterior chain and spinal mobility, and lower-limb explosive strength. Speed and shuttle performance were measured on court using spatial references and manual timing with a stopwatch. Flexibility was evaluated using the sit-and-reach procedure. Explosive strength was assessed through vertical jump tests, specifically squat jump (SJ) and countermovement jump (CMJ), performed on a dynamometric platform to obtain objective jump height values.

Statistical Analysis

Given the exploratory and pilot nature of the study, statistical analysis was primarily descriptive. For each anthropometric and motor variable, the main summary statistics were calculated, including mean values, minimum and maximum scores, and overall distribution trends within the group. BMI values were computed from measured height and body mass and interpreted according to standard classification criteria. The descriptive outcomes were then examined in relation to the initial research hypotheses, with particular attention to whether the observed profile appeared consistent with, or distant from, the reference standards reported by the FITP for U18 players of national interest. This descriptive-comparative approach was adopted to provide a preliminary interpretation of the sample's performance characteristics and to support future research development with larger cohorts and more advanced inferential designs.

Results

Motor performance outcomes are presented first, followed by anthropometric characteristics. The sample showed a clear inter-individual variability across all functional measures, with performance ranges that highlight meaningful differences even within a relatively homogeneous age category. In the 10-m sprint test, completion time ranged from 1.97 s to 2.20 s, with a mean value of 2.07 s (Fig. 1).

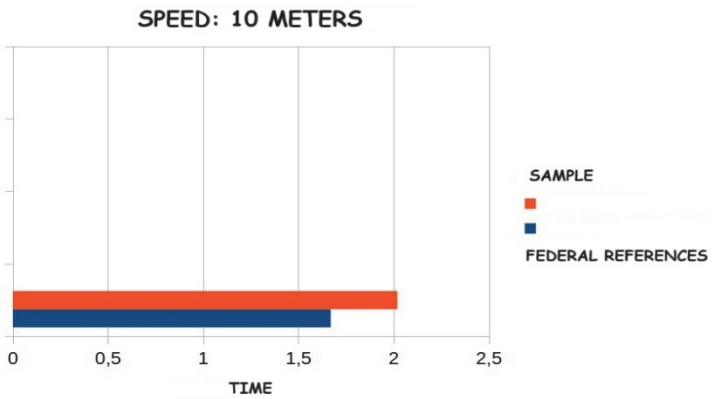

Fig. 1 - Quick 10mt results

The 8-m shuttle test (6 repetitions) showed a wider dispersion, with times ranging from 13.60 s to 15.97 s and an average performance of 14.77 s (Fig. 2).

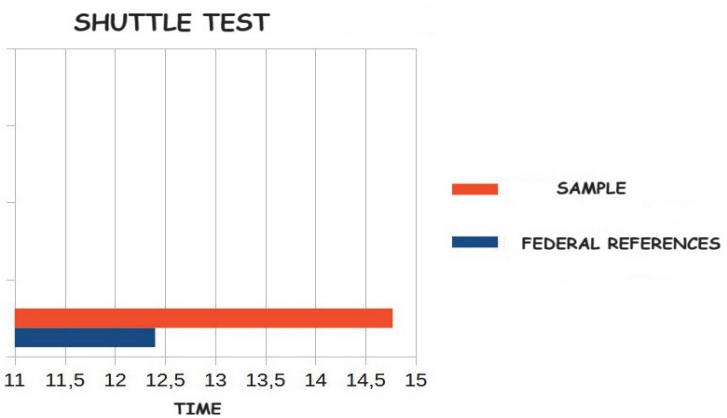

Fig. 2 - 8mt shuttle results

Regarding lower-limb explosive strength, squat jump (SJ) height ranged from 21.7 cm to 30.8 cm, with a mean jump height of 24.87 cm. Comparable values were observed in the countermovement jump (CMJ), with results ranging from 21.1 cm to 30.4 cm and an average of 24.41 cm (Fig. 3).

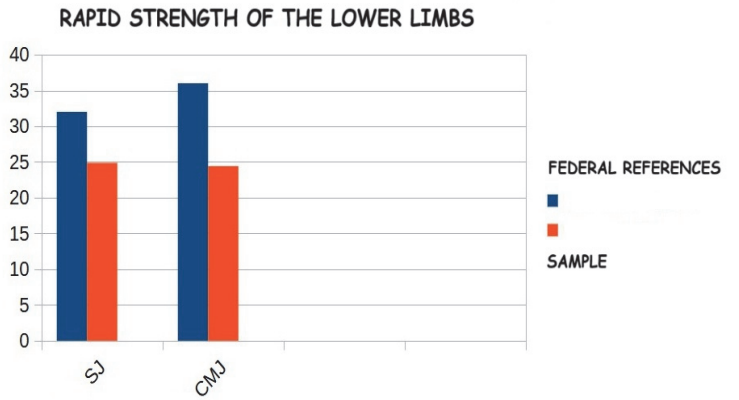

Fig. 3 - Results of rapid strength of the lower limbs

Flexibility, assessed through the sit-and-reach test, was generally positive across the group. Values ranged from − 9 cm to + 9 cm, with most athletes scoring above zero and a mean reach distance of + 9 cm (Fig. 4).

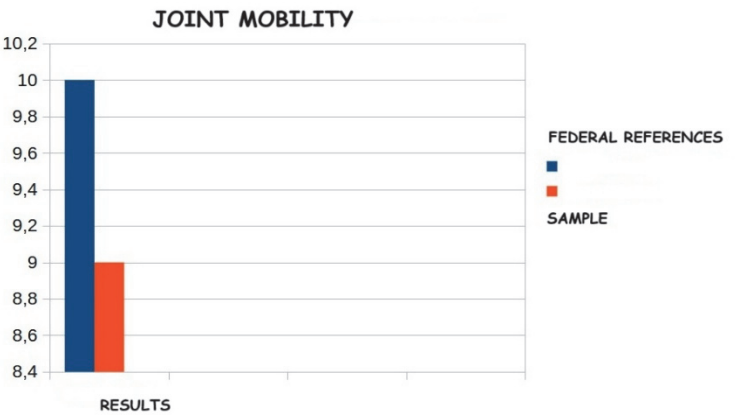

Fig. 4 - Sit and reach results

Anthropometric profiling indicated an average height of 159.7 cm and an average body mass of approximately 57.0 kg (Figs. 5-6). BMI values were largely consistent with a normal-weight profile, with 90% of participants classified within the normal range according to the adopted criteria (Fig. 7).

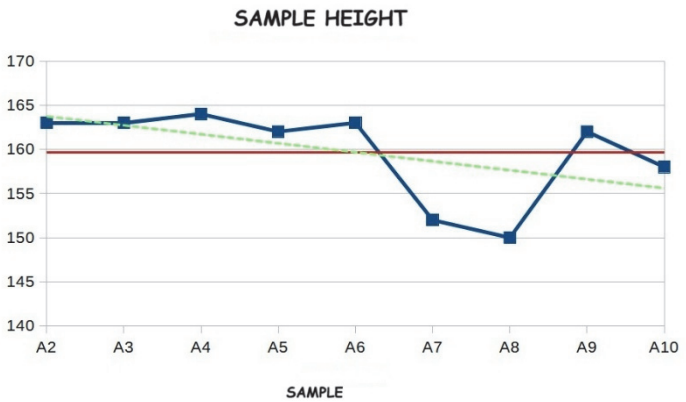

Fig. 5 - Sample height

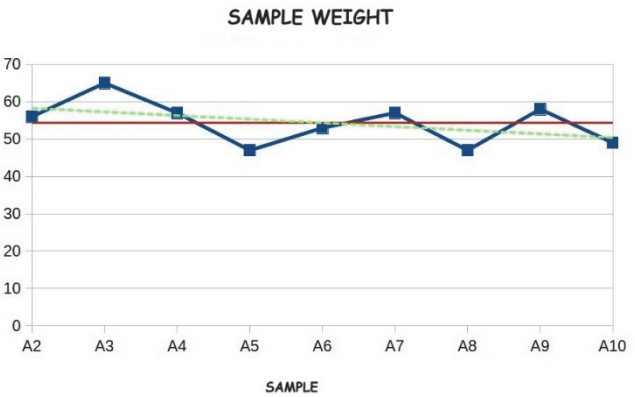

Fig. 6 - Sample weight

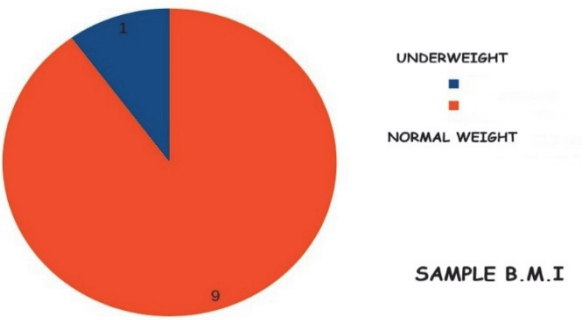

Fig. 7 - BMI of the sample

Table 1 - Descriptive statistics of anthropometric and motor variables (n = 10)

Domain	Variable	Unit	Mean	SD	Min–Max
Motor performance	10-m sprint time	s	2.07	0.07	1.97-2.20
Motor performance	8-m shuttle (6 reps) time	s	14.77	0.78	13.60-15.97
Motor performance	Squat Jump (SJ) height	cm	24.87	2.85	21.7-30.8
Motor performance	Countermovement Jump (CMJ) height	cm	24.41	2.72	21.1-30.4
Mobility/ Flexibility	Sit-and-reach	cm	+6.9	4.9	−9-+9
Anthropometry	Height	cm	159.7	5.8	151.0-169.0
Anthropometry	Body mass	kg	57.0	6.1	48.0-67.0
Anthropometry	BMI	kg/m²	22.3	1.8	19.1-25.8

Comparison with FITP reference benchmarks

To put the results in context, we compared the group data with FITP reference values for U18 athletes of national interest. In the 10-m sprint, the sample averaged 2.07 ± 0.07 s, while the FITP benchmark is 2.01 ± 0.05 s. This points to slightly weaker early acceleration. The same gap appears in repeated change-of-direction performance. Shuttle time was 14.77 ± 0.78 s in the present group, compared with 14.10 ± 0.60 s in the FITP reference, suggesting lower efficiency when directional changes are repeated at high intensity.

Jump outcomes were closer to the federation profile. Squat jump reached 24.87 ± 2.85 cm and countermovement jump 24.41 ± 2.72 cm, versus FITP values of 26.50 ± 2.60 cm (SJ) and 26.10 ± 2.50 cm (CMJ). The difference is small, but still present. Flexibility showed almost no discrepancy (sit-and-reach: +6.9 ± 4.9 cm vs +7.5 ± 4.0 cm), indicating no relevant limitation in posterior-chain mobility at group level.

Overall, the sample aligns more closely with FITP values in flexibility and explosive strength. Speed and repeated change-of-direction remain the main areas where the distance from the benchmark is clearer, and these qualities are key for court coverage and progression toward higher competitive levels.

Discussion

The present study aimed to clarify performance-related profiling in youth women's tennis by combining basic anthropometric description with field-based motor indicators linked to athletic readiness. Results were then interpreted through a descriptive comparison with FITP reference benchmarks for U18 athletes of national interest. The goal was not to generate predictive claims. Rather, the study provides an initial snapshot that may support monitoring practices and a more sustainable approach to development in late-adolescent female players.

Overall, the group showed a physical profile compatible with healthy development and regular competitive participation, while some motor qualities displayed a clearer distance from federation benchmarks. From an anthropometric standpoint, mean height (159.7 cm) and body mass (≈57 kg) described a typical profile for the age range, with BMI values mostly within a normal-weight range. These measures are not intended to define an "ideal" body type. They are useful mainly as context for reading the functional outcomes. This point matters in applied settings, where anthropometric traits can still influence informal selection decisions, especially in tennis, where height is often associated with serving advantage and first-strike effectiveness. In the present sample, however, anthropometry alone does not explain the variability observed in motor performance. This supports a key developmental message, namely taht in adolescence, morphology should not be treated as a gatekeeping criterion. Maturation-related differences can be temporary, and their apparent "advantage" may change over time. A more sustainable approach is to consider anthropometry as background information that interacts with trainable qualities and movement efficiency (Reid et al., 2009).

Motor performance results showed a more differentiated pattern. Short sprint performance (10 m) averaged 2.07 s, while repeated change-of-direction performance (8 m shuttle ×6) averaged 14.77 s. Compared with FITP benchmarks, both outcomes appear slightly lower, pointing to a potential margin in early acceleration and repeated high-intensity movement efficiency. These qualities are central in tennis because they directly affect court coverage and time-to-ball. Even a small delay in early acceleration can reduce shot options and increase the likelihood of defensive play. Similarly, less efficient repeated directional changes may reduce movement quality over longer rallies and multiple games, potentially increasing fatigue-related technical errors. From a practical standpoint, the results do not suggest poor performance. They highlight an area where training could be more targeted, especially through neuromuscular work aimed at acceleration mechanics,

braking control, and re-acceleration quality. This fits well with a sustainable development framework: improvements in speed and COD should be built progressively, with technical emphasis and injury-prevention priorities, rather than through excessive loads or early specialization (Chapelle et al., 2022).

In contrast, explosive lower-limb strength appeared closer to the federation profile. Squat jump and countermovement jump values (24.87 cm and 24.41 cm) showed only a modest gap compared with FITP references. This is relevant because vertical jump tests are commonly used as practical proxies for neuromuscular readiness and explosive capacity in field settings. At the same time, it would be reductive to interpret SJ and CMJ as a complete representation of tennis-specific power. Tennis requires explosive force in horizontal and multi-directional patterns, often under asymmetrical and rapidly changing conditions. Still, SJ and CMJ remain useful monitoring tools. In applied terms, the combination of relatively "closer" jump values and slightly lower sprint/shuttle outcomes may suggest that training priorities should focus less on increasing generic power and more on how force is expressed in tennis-relevant movement tasks (movement efficiency, acceleration quality, repeated directional changes) (Zurano et al., 2025).

Flexibility outcomes, assessed through the sit-and-reach test, were broadly comparable to FITP values, with most athletes scoring in the positive range. Flexibility is not always discussed as a primary performance driver, yet in tennis it can influence reach, stability in extreme positions, and recovery during defensive phases. In youth female athletes, mobility can also interact with injury risk, particularly during periods of growth and movement reorganization. In the present group, posterior-chain flexibility does not appear to be a major limitation (Chapelle et al., 2023). Still, the variability observed at individual level remains relevant, because even one athlete with reduced mobility may be exposed to higher risk when training volumes increase or when repeated high-intensity actions accumulate. In this sense, flexibility screening may be more useful as an individual monitoring tool than as a group-level performance determinant.

One of the main contributions of this pilot work is the emphasis on variability, even within a small and relatively homogeneous group. Performance ranges were not narrow, especially in repeated movement tasks. This aligns with a common principle in youth sport science, namely that late adolescence is not a uniform stage. Players of the same age can differ in readiness due to maturation timing, training exposure, and movement quality (Hizan et al., 2011). The practical implication is straightforward. Development pathways should be individualized. A sustainable performance model is not one that identifies a single "ideal athlete" profile, but one that

provides reference ranges and indicators that help guide decisions without forcing all athletes into the same template (Skorodumova et al., 2022).

The descriptive comparison with FITP benchmarks adds an applied layer to this interpretation. It helps clarify where the sample aligns with higher-level expectations and where the distance is more evident. In this dataset, the clearest margins appear in speed and repeated change-of-direction performance, while explosive strength and flexibility are closer to the federation profile. For coaches, this kind of information can support prioritization. It also promotes a more rational development approach, rather than relying on non-trainable traits or general impressions, practitioners can focus on qualities that are relevant for tennis and responsive to structured training. From a sustainability perspective, this is important. Youth programs should aim to build a broad and resilient athletic base, limit early specialization, and reduce the temptation to chase short-term gains through excessive loading. A more sustainable route emphasizes progressive improvement in movement quality, neuromuscular control, and repeatability of high-intensity actions.

Anthropometry deserves a final note. Although height and body mass were reported descriptively and BMI suggested a generally healthy status, these measures should not be interpreted as predictors of elite potential. Tennis literature often highlights stature as a serving advantage, but women's tennis is tactically diverse, and movement efficiency can be decisive. Moreover, in youth categories, maturation can distort the relationship between body size and performance. For this reason, the present findings support an approach where anthropometry is used as contextual information for training and monitoring, not as a selection filter. This is consistent with the broader logic of sustainable athlete development, which aims to keep development opportunities open and to support progression through trainable qualities and skill acquisition (D'Hondt, & Chapelle, 2024).

Future research should build on these exploratory results with larger samples and stronger designs. Integrating maturation status and training history would help interpret variability more precisely, separating differences driven by biological development from those linked to training adaptation (Montesano et al., 2013). Longitudinal monitoring across a season would also be valuable, as sustainability is reflected not only in absolute values but in the capacity to improve while remaining healthy and consistently available for training and competition (Di Palma et al., 2025). Finally, a more complete performance model would benefit from integrating match-related variables and technical–tactical indicators, which remain essential components of tennis performance (Kramer et al., 2016).

Several limitations should be acknowledged. The sample size was small (n = 10), limiting generalizability and restricting the strength of inferential conclusions. Recruitment was based on convenience sampling, so the profile may reflect local characteristics rather than the broader population of youth female tennis players. The design was cross-sectional, providing a snapshot rather than developmental evidence. Sprint and shuttle timing relied on manual stopwatch procedures, which may introduce measurement error compared with electronic systems. FITP benchmarks offer a useful reference, but they may vary depending on testing conditions and selection criteria, and should be interpreted as indicative rather than absolute. Finally, the study focused on physical and functional indicators and did not include technical, tactical, or match-analysis measures, which would be required for a fully comprehensive performance model.

Conclusions

This pilot study describes the physical and functional profile of competitive female tennis players aged 14–17 years using field-based assessments, and it compares the results with FITP reference values for U18 athletes of national interest. The sample showed a generally healthy anthropometric profile. Flexibility and lower-limb explosive strength were broadly close to federation standards, whereas sprint and repeated change-of-direction performance were lower. This gap points to acceleration and movement efficiency under repeated high-intensity efforts as potential priority areas for development in this age group.

From a practical standpoint, combining basic anthropometric monitoring with functional performance testing may support more individualized training decisions. It also encourages a longer-term view of development, based on progressive improvement, appropriate load management, and attention to movement quality. At the same time, the variability observed within a small group confirms that players of similar age can differ in readiness, and may therefore require different training priorities rather than uniform prescriptions. Future research should extend these findings with larger samples and longitudinal designs, and should include maturation status, training history, and match-related indicators to improve the interpretation of performance profiles and support a more comprehensive and sustainable performance model for late-adolescent female tennis players.

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Artificial Intelligence and the Transformation of Management Models: Governance Challenges and Sustainability Opportunities in Healthcare Organizations

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Abstract
The article examines artificial intelligence as a driver of management model transformation in healthcare organizations. It analyzes how AI influences strategic planning, operational coordination, resource allocation, performance monitoring, and decision support. Particular attention is paid to governance conditions, including data governance, accountability, transparency, workforce readiness, and institutional oversight. The article argues that AI contributes to sustainable organizational development only when embedded in coherent management models supported by responsible governance. A conceptual framework linking AI capabilities, governance conditions, transformation processes, organizational outcomes, and sustainability outcomes is proposed.
Keywords: artificial intelligence; management model transformation; healthcare organizations; governance; sustainability

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Introduction

Artificial intelligence (AI) is increasingly recognized as a transformative organizational capability that affects management, decision-making, and institutional performance in healthcare (OECD, 2025b; World Health Organization [WHO], 2025a). Earlier debates in the field focused mainly on diagnostic accuracy, clinical decision support, and health data analytics. Recent evidence, however, shifts attention to systemic issues: governance models, legal and ethical frameworks, workforce readiness, data

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management, stakeholder engagement, and implementation capacity (WHO, 2025a). Therefore, the relevance of AI for healthcare organizations lies not merely in the availability of digital tools, but in the way these tools reshape planning, coordination, monitoring, and adaptation over time.

This shift is particularly important for healthcare organizations, where management operates in extremely complex environments characterized by limited resources, increasing service demands, regulatory pressure, and rising expectations for quality, safety, transparency, and accountability. The WHO European Region State of Preparedness Report highlights that AI is already changing approaches to planning, delivery, and management of healthcare systems, and reveals important gaps in governance capacity, national strategies, workforce readiness, and data management (WHO, 2025a). These developments demonstrate that the significance of AI in healthcare extends far beyond clinical innovation and must increasingly be considered in terms of organizational management and institutional sustainability.

Despite this growing relevance, the managerial consequences of AI remain less systematically examined than its clinical and technical applications. Research still gives substantial attention to algorithmic performance, diagnostic use cases, and patient-facing ethical concerns, whereas AI-driven changes in strategic planning, resource allocation, personnel management, performance monitoring, and risk forecasting are discussed less coherently. This gap is important because such functions determine whether AI leads to isolated administrative improvements or to a more data-driven, predictive, and adaptive management model (OECD, 2025b; Papagiannidis et al., 2025).

However, the transformative potential of AI does not automatically guarantee sustainable organizational outcomes. Without clear governance mechanisms, robust data management, leadership capacity, staff readiness, and accountability mechanisms, AI can reproduce bias, weaken trust, increase operational opacity, or introduce new forms of institutional risk. Recent research in healthcare governance argues that effective AI adoption depends not only on technological sophistication but also on organizational structures capable of overseeing implementation throughout the lifecycle of AI systems (Hassan et al., 2025). More broadly, responsible AI governance is viewed as a combination of structural, relational, and procedural practices that determine how organizations balance innovation with control, legitimacy, and long-term institutional effectiveness (Papagiannidis et al., 2025). Thus, healthcare organizations represent a particularly valuable context for exploring the relationship between AI, governance, and

sustainability, as they combine high societal value with stringent regulatory constraints and significant managerial interdependencies.

For the purposes of this article, sustainability is interpreted broadly: it includes financial and environmental responsibility, but also continuity of services, workforce resilience, institutional learning, adaptive capacity, and public legitimacy. AI can support these dimensions by improving forecasting, coordination, responsiveness, and organizational learning. Yet these benefits depend on whether AI is embedded in management models that are strategically governed, ethically sound, and institutionally sustainable (OECD, 2025b; WHO, 2025a).

Against this backdrop, the article examines how AI reshapes management processes in healthcare organizations and identifies the governance conditions under which such transformation can strengthen sustainable and resilient institutional development. The analysis is guided by three research questions: How is AI transforming management models in healthcare organizations? Which governance issues most significantly affect its implementation? Under what conditions can AI contribute to organizational sustainability and resilience?

Literature Review

The growing role of artificial intelligence in modern organizations has expanded the concept of digital transformation beyond automation and technological modernization. AI increasingly functions as a strategic organizational capability that supports information processing, workflow coordination, resource allocation, and decision-making. This broader view is especially relevant for complex institutions, where management effectiveness depends on the ability to integrate data, anticipate change, and respond adaptively to internal and external pressures (OECD, 2025b; Papagiannidis et al., 2025).

From a management perspective, AI-driven transformation is associated with a shift from fragmented and reactive management to more predictive, data-driven, and coordinated models of organizational control. OECD analyses highlight that AI can improve productivity, responsiveness, policy implementation, and accountability, but only if it is integrated into appropriate management mechanisms and supported by organizational factors such as digital capacity, leadership, data infrastructure, and responsible oversight (OECD, 2025b). In this sense, AI does not simply optimize existing management functions; it can change the underlying governance logic, altering how organizations set priorities, manage risks,

and evaluate results. This approach directly links AI with the literature on management model transformation, organizational agility, and strategic decision support.

This challenge is particularly pressing in healthcare organizations, where digital transformation occurs under conditions of high complexity, regulatory oversight, and operational interdependence. AI is increasingly connected with planning, performance monitoring, patient-flow coordination, administrative burden reduction, resource planning, and operational forecasting (WHO, 2025a; Wells et al., 2025). Contemporary implementation concepts therefore suggest that AI should be considered within a broader management ecosystem, rather than treated as an isolated technical intervention (Wells et al., 2025).

At the same time, the rapid spread of AI has increased scholarly attention to management issues. AI governance has become an important area of research, as the implementation of AI in organizations raises issues that cannot be addressed through technical design alone. These issues relate to accountability, transparency, fairness, oversight, legal compliance, human oversight, and the institutional mechanisms needed to manage risks throughout the lifecycle of AI systems (Papagiannidis et al., 2025; WHO, 2025a). In a recent review and research framework, Papagiannidis et al. (2025) consider responsible AI governance as a combination of structural, relational, and procedural practices that shape how organizations develop, implement, and manage AI. This perspective is particularly valuable because it shifts the discussion from abstract ethical principles to concrete organizational mechanisms and governance capabilities.

In healthcare, governance issues are even more pressing as AI systems are deployed in environments where decisions impact safety, continuity of care, public trust, and resource allocation. WHO documents highlight that the implementation of AI in health systems depends on legal and ethical frameworks, data governance, workforce readiness, stakeholder engagement, and institutional readiness (WHO, 2025a). Similarly, governance-focused research in health governance argues that organizations need formal implementation pathways, review mechanisms, and internal structures capable of assessing AI systems before and after implementation (Hassan et al., 2025; Kim et al., 2025). Kim et al. (2025), for example, demonstrates that practical AI governance in a large health organization can be structured through the interaction of people, processes, technology, and operations, thereby supporting the idea that AI governance is not an abstract principle but an operational and managerial necessity.

The literature also suggests that AI governance should not be understood solely as a risk-control mechanism. It is equally important as a condition

for fostering sustainable organizational innovation. Without governance, AI adoption may remain fragmented, opportunistic, or unstable; with governance, organizations are better prepared to align innovation with institutional strategy, accountability, and long-term value creation (OECD, 2025b; Papagiannidis et al., 2025). This understanding is particularly relevant to this study, as it links management transformation to the broader issue of sustainability.

The concept of sustainability has also evolved beyond environmental or financial considerations. In organizational studies, it increasingly refers to the long-term capacity of institutions to function effectively, manage resources responsibly, adapt to instability, support human capacity, and maintain legitimacy in changing conditions. This perspective is highly relevant in healthcare, where sustainability is inseparable from continuity of care, quality assurance, public trust, and the capacity to respond to rising demand and systemic uncertainty (WHO, 2025a).

However, the link between AI and resilience in healthcare is not automatic or unambiguously positive. Literature suggests that AI can contribute to organizational sustainability only when its implementation is aligned with management capacity, institutional goals, workforce adaptation, and ethical safeguards (OECD, 2025; Wells et al., 2025). This means that resilience should be approached as an indirect outcome of AI-enabled transformation, rather than as a direct byproduct of digital technology adoption. In practice, AI can improve operational resilience through more efficient resource allocation, institutional resilience through enhanced adaptability and strategic coordination, and staff resilience through decision support and reduced workload. However, these effects remain dependent on how management models are designed and governed.

Taken together, the literature points to three conclusions that structure the remainder of the article. First, AI should be analyzed as an organizational capability that reshapes management processes. Second, governance determines whether this capability becomes a source of value or a source of risk. Third, sustainability in healthcare depends on the degree to which AI is integrated into responsible, strategically coordinated, and institutionally grounded management practices.

Methodological Approach

This study is a theoretical and analytical article based on a structured review of academic and policy literature on artificial intelligence, management model transformation, corporate governance, and

sustainability in healthcare organizations. The chosen approach reflects the exploratory and integrative nature of the problem. Since the aim of the article is not to test a single causal hypothesis, but to synthesize and interpret the key conceptual, organizational, and managerial aspects of AI-enabled management transformation, a structured analytical review is more appropriate than a narrowly empirical or purely technical approach (Papagiannidis et al., 2025; World Health Organization [WHO], 2025a).

The methodological logic of the study is based on the assumption that artificial intelligence should be viewed not only as a technological innovation but also as an organizational and managerial phenomenon embedded in a broader institutional, ethical, and managerial context. For this reason, the analysis combines two categories of sources. The first group includes peer-reviewed academic publications on AI governance, digital transformation, organizational management, and health systems implementation. The second group includes international policy and institutional documents, particularly reports from the World Health Organization and the OECD, which provide up-to-date data on AI readiness, governance conditions, barriers to implementation, and strategic implications for public and health-related organizations (OECD, 2025b; WHO, 2025a). This dual-source strategy allows us to connect conceptual research with policy-relevant and practically relevant perspectives.

The review prioritized publications from 2019 to 2026 because this period reflects the acceleration of AI adoption, the expansion of responsible AI governance debates, and the emergence of institutional implementation frameworks in healthcare and public-sector contexts. Earlier landmark sources were considered selectively when they made a significant conceptual contribution to understanding digital transformation or organizational management.

The search strategy was organized around several interrelated thematic clusters. Key search terms included combinations of "artificial intelligence," "management transformation," "management models," "organizational change," "AI governance," "healthcare organizations," "healthcare systems," "operational management," "sustainability," and "resilience." Priority was given to studies addressing the intersection of AI implementation, governance mechanisms, operational use, and sustainability-related outcomes (Hassan et al., 2025; Wells et al., 2025).

To ensure analytical consistency, a set of inclusion and exclusion criteria was applied throughout the study. Sources were included if they met at least one of the following conditions:

- they examined AI in the context of organizational governance, management, implementation, or institutional strategy;

- they focused on healthcare organizations or health systems as organizational environments;
- they addressed issues of responsible AI governance, including accountability, oversight, transparency, data management, workforce readiness, or institutional assurance;
- they provided information on sustainability, viability, or long-term organizational effectiveness in the context of AI-driven transformation.

Sources were excluded if they were limited to highly technical descriptions of algorithms, purely clinical diagnostic applications without organizational implications, or general articles without analytical or policy significance. This selection logic helped maintain the article's focus on management model transformation rather than the application of AI in the abstract (Kim et al., 2025; Wells et al., 2025).

Following identification and selection of sources, the selected literature was analyzed using a thematic synthesis. Rather than statistically summarize the results, the study categorized and interpreted the literature according to the main analytical dimensions structuring the article:

(1) AI as a driver of management model transformation;
(2) governance challenges of AI-enabled management;
(3) operational implications of AI implementation; and
(4) sustainability and resilience outcomes in healthcare organizations.

This thematic approach was chosen because it supports conceptual integration across diverse sources, including scientific reviews, governance frameworks, implementation studies, and policy reports. It also enables the development of a synthetic interpretive model linking AI resources and capabilities to governance conditions, management transformation processes, organizational outcomes, and sustainability effects (Papagiannidis et al., 2025; OECD, 2025b).

The study does not claim to be a formal systematic review in the strict methodological sense. Instead, this article adopts a structured and conceptually oriented review approach, aiming to identify the most relevant analytical models, governance challenges, and institutional implications associated with the application of AI in healthcare management. This approach aligns with the article’s goal of clarifying an emerging research area and developing a holistic conceptual framework, rather than focusing on effect size measurements or clinical outcome comparisons. In this regard, the methodology is consistent with recent research in the field of governance and implementation, which emphasizes the need for integrative, organizationally informed, and policy-sensitive approaches to AI implementation in healthcare settings (Hassan et al., 2025; Wells et al., 2025; WHO, 2025a).

Finally, the article's methodological focus is distinctly interdisciplinary. It draws on governance research, digital transformation literature, management studies, and health systems analysis to capture the multidimensional nature of AI-driven organizational change. This approach is particularly relevant for healthcare organizations, where management model transformation cannot be adequately understood through a single disciplinary lens. By combining conceptual synthesis with policy and organizational analysis, this study seeks to lay a solid foundation for examining AI as a driver of management model transformation in the face of institutional complexity, governance constraints, and sustainability pressures (OECD, 2025b; WHO, 2025a).

Artificial Intelligence as a Driving Force in the Transformation of Management Models

Building on this literature, AI can be conceptualized as a force that restructures the internal architecture of organizational management. Its implementation influences how organizations collect and interpret information, set priorities, coordinate activities, allocate resources, and evaluate results (OECD, 2025b; Papagiannidis et al., 2025). Rather than only accelerating individual administrative tasks, AI can enable new forms of organizational intelligence that are more predictive, adaptive, and data-driven.

From a management perspective, one of the most significant effects of AI is the shift from reactive to proactive management. Traditional management models often rely on retrospective reporting, delayed feedback, and fragmented decision-making processes. In contrast, AI-powered systems enable organizations to process large volumes of real-time and historical data, identify patterns, anticipate emerging needs, and support proactive action. OECD analyses note that AI can improve productivity, responsiveness, and accountability by improving the quality and timeliness of decision-making, especially when organizations create enabling conditions for robust and well-governed use (OECD, 2025b). As a result, management becomes less reliant on intuition or delays in administrative signals and more focused on continuous monitoring, predictive assessment, and coordinated response.

The second dimension of transformation concerns operational management. AI enables organizations to redesign workflows, optimize planning, support capacity planning, and improve coordination across departments and processes. In healthcare organizations, these functions are

particularly important, as operational bottlenecks often have direct consequences for service continuity, workload distribution, patient flow, and resource efficiency. Recent implementation-focused research shows that AI can facilitate a reduction in administrative burden, operational forecasting, and more systematic analysis of institutional processes, provided its use is integrated into practical management and implementation frameworks (Wells et al., 2025). In this regard, AI contributes not only to the acceleration of operations but also to the creation of a more integrated operational management model in which processes become increasingly measurable, interconnected, and responsive to changing organizational needs.

AI is also transforming strategic management, influencing how leaders interpret complexity, assess risks, and set institutional priorities. In traditional strategic planning, management decisions are often dependent on periodic reviews, limited forecasting capabilities, and partial access to relevant data. AI can improve this process by providing more dynamic analytical support for scenario planning, resource allocation, risk prediction, and long-term organizational adaptation. An AI maturity roadmap developed for healthcare systems suggests that effective and sustainable AI implementation depends not only on governance and infrastructure but also on business execution, value orientation, and the integration of AI into broader organizational strategy (Durlach et al., 2024). This emphasizes that AI is not only an operational innovation but also a strategic management issue, capable of influencing the direction of an organization and how it defines and pursues value creation.

Another important area of transformation concerns performance management and evaluation. Artificial intelligence enhances organizations' ability to track metrics, identify deviations, and obtain performance information in real time. This can strengthen management oversight and enable organizations to respond more quickly to inefficiencies, emerging risks, or imbalances in service delivery. At the same time, this transformation raises important questions about what is being measured, how algorithm results are interpreted, and how accountability is allocated when AI becomes part of institutional performance measurement systems. For this reason, performance transformation should not be understood solely in technical terms. It also impacts the epistemological foundation of management, as the categories through which organizations perceive performance, risk, or success may be increasingly mediated by AI-enabled analytics (Papagiannidis et al., 2025).

In healthcare organizations, these transformations are particularly noticeable, as management operates at the intersection of clinical,

administrative, regulatory, and societal expectations. Artificial intelligence can support strategic and operational decision-making in areas such as workforce allocation, demand forecasting, service coordination, identifying process inefficiencies, and prioritizing organizational interventions. The WHO emphasizes that AI is already changing approaches to planning, delivery, and management of health systems, thus reaffirming the need to analyze its organizational significance beyond clinical innovation alone (World Health Organization [WHO], 2025a). Similarly, applied health research argues that the value of AI depends on whether organizations view its implementation as part of a broader management ecosystem, rather than as a standalone digital solution (Wells et al., 2025). This suggests that the integration of AI into healthcare is most meaningfully understood as a transformation of management models, rather than a simple extension of existing digital tools.

At a deeper level, AI-driven transformation can be interpreted as a shift from hierarchical and fragmented management structures to more networked, coordinated, and learning-oriented organizational forms. AI systems enable cross-functional information flows, accelerate feedback, and create opportunities for closer interactions between data, operations, and decision making. However, these benefits are not automatic. Organizations must develop management capacity to interpret AI results, integrate them into institutional procedures, and balance efficiency gains with accountability, ethical safeguards, and human judgment. As modern management concepts demonstrate, organizational transformation through AI depends not only on technological capabilities but also on leadership, workforce readiness, clear implementation paths, and oversight mechanisms throughout the lifecycle of AI systems (Hassan et al., 2025; Kim et al., 2025). Therefore, management transformation should be viewed as a socio-technical process, not a purely technological one.

It is important to note that AI does not replace management; rather, it restructures the conditions under which governance occurs. Managers remain responsible for priority setting, interpretation, and institutional accountability, but their work is increasingly mediated by tools that work with large volumes of data, which influence how problems are framed and how solutions are selected. This is changing both the scale and nature of governance work. Decision making is becoming more distributed between human and technological systems, while strategic oversight requires greater attention to data quality, the interpretability of results, governance safeguards, and organizational trust. In this regard, AI is transforming governance models not only by increasing efficiency but also by redefining

how power, coordination, and knowledge are organized within institutions (OECD, 2025b; Papagiannidis et al., 2025).

Taken together, the literature indicates that AI-driven transformation affects healthcare management at strategic, operational, evaluative, and organizational levels. AI can support more adaptive, predictive, and integrated management models. However, this transformation depends on the governance and organizational context in which AI is implemented.

Governance Challenges in AI-Enabled Management Transformation

The organizational value of AI depends on the governance conditions that shape how systems are selected, implemented, monitored, and revised over time. Contemporary governance research therefore treats AI as a socio-technical and institutional phenomenon. Governance links innovation with accountability, strategic objectives, and risk management, while broader frameworks such as the NIST AI Risk Management Framework emphasize lifecycle-based control rather than one-time technical validation (National Institute of Standards and Technology [NIST], 2023; OECD, 2025b; Papagiannidis et al., 2025).

One of the most fundamental governance challenges concerns data governance. AI governance depends on the quality, interoperability, traceability, representativeness, and legitimate use of data. However, in healthcare organizations, data environments are often fragmented by legacy systems, uneven standards, incomplete interoperability, and varying degrees of digital maturity. The WHO has emphasized that effective data governance in healthcare is essential for building trusted, digital health systems, especially when AI systems rely on large volumes of sensitive and operationally critical information (World Health Organization [WHO], 2025b). Previously, the WHO guidance on the ethics and governance of AI in health also stated that privacy protection, data governance, and the quality of training and operational data are necessary conditions for the responsible implementation of AI (WHO, 2021). From a governance perspective, weak data governance undermines not only compliance but also the accuracy of forecasting, performance monitoring, resource allocation, and the legitimacy of AI-based decision-making.

The second challenge concerns accountability and oversight throughout the lifecycle. As AI is integrated into governance processes, organizations must determine who is responsible for the consequences of AI-enabled decisions, how performance is measured over time, and what escalation

mechanisms exist when systems perform poorly or cause unintended harm. The NIST framework is particularly useful in this context because it views AI governance as a continuous process of managing, mapping, measuring, and controlling risks, rather than a one-time approval (NIST, 2023). Research in healthcare supports this thesis. Hassan et al. (2025) argue that healthcare organizations need clearly defined governance structures and implementation mechanisms capable of structured management of AI implementation. Similarly, the FAIR-AI framework proposed by Wells et al. (2025) emphasizes that responsible implementation requires organizational elements, designated personnel, multidisciplinary review processes, and an inventory mechanism that ensures transparency and continuous monitoring. Taken together, these studies show that governance failures often arise not from a lack of AI tools, but from a lack of institutional accountability mechanisms.

Closely related to accountability is the issue of transparency, explainability, and fairness. Artificial intelligence can improve governance, but its organizational legitimacy depends on whether decision-makers can understand, communicate, and justify how the results are produced and used. In healthcare and the public interest, opaque systems can weaken trust, obscure accountability, and make it difficult to defend institutional decisions to staff, regulators, or the public. The 2021 WHO guidelines identify transparency, understandability, and accountability as core ethical requirements for AI in healthcare, while more recent case studies of implementation in healthcare operationalize these concerns through principles such as fairness, trustworthiness, privacy, security, transparency, explainability, accountability, and usefulness (Saenz et al., 2024; WHO, 2021). Panteli et al. (2025), addressing the issue from a public health policy perspective, also argue that accountability, data privacy, staff qualifications, and robust regulatory frameworks are necessary for AI to support public and health sector decision-making without exacerbating inequalities. Thus, interpretability is not simply a technical issue; it is a governance condition for maintaining institutional legitimacy.

Another major challenge relates to staff readiness and managerial capacity. AI governance is unlikely to be successful unless managers and staff have the skills necessary to interpret AI output, question limitations, integrate systems into workflows, and make informed decisions in high-stakes situations. A WHO regional readiness assessment shows that AI adoption in health systems is closely linked to staff readiness, stakeholder engagement, governance models, and institutional capacity (WHO, 2025a). This thesis is further supported by research in real-world healthcare practice. Kim et al. (2025) demonstrate that establishing an AI governance

system at a Canadian healthcare organization required attention not only to technology but also to people, processes, and operations. Stetson et al.'s (2025) report on responsible governance of AI in oncology also shows that governance in practice relies on multidisciplinary committees, program-level oversight, model registration, risk assessment tools, and lifecycle management processes. These examples demonstrate that readiness is not simply individual digital literacy; it is organizational capacity distributed across management, technical groups, clinical or operational stakeholders, and institutional oversight structures.

Governance challenges also arise around leadership, procurement, and implementation pathways. Organizations often approach AI as a procurement or innovation issue, focusing on acquiring tools rather than establishing governance structures that can evaluate long-term feasibility, risks, and organizational value. However, recent policy and implementation literature suggests that procurement itself is a key governance challenge. The OECD identifies procurement capacity as a prerequisite for the effective use of AI in the public sector and public services, as poorly managed procurement can lead to weak provider accountability, inconsistent standards, and mission drift (OECD, 2025b). In healthcare, Wells et al. (2025) also argue that institutions need practical pre- and post-implementation review mechanisms, while Vardas et al. (2025) note that the implementation of the EU AI Act raises important questions regarding risk categorization, post-marketing monitoring, transparency, fairness, and the allocation of responsibility in high-risk healthcare applications. These findings indicate that governance begins well before implementation and continues throughout the lifespan of AI systems.

Another governance challenge concerns regulatory alignment and institutional coherence. Healthcare organizations operate in a multi-layered environment shaped by privacy law, professional liability, digital health policy, procurement regulation, and sectoral standards. AI adds further complexity because internal innovation strategies must be aligned with external regulatory frameworks, including risk-based approaches to high-impact healthcare applications (Vardas et al., 2025; WHO, 2025a).

Finally, trust and legitimacy should be considered as independent governance outcomes. The trustworthiness of AI is not only determined by technical reliability; it also depends on whether organizations can demonstrate that AI-enabled governance remains ethically sound, auditable, and consistent with public and professional expectations. The WHO (2021) explicitly links AI governance in healthcare to human well-being, autonomy, transparency, and accountability, while the OECD (2025b) emphasizes that public trust depends on both fostering innovation and

visible risk management. In the public health literature, Panteli et al. (2025) further emphasize that effective AI adoption requires institutions to prioritize equity, regulatory literacy, secure data processing, and workforce development. For healthcare organizations, this means that AI governance is not only an internal control mechanism but also a source of external legitimacy. Poorly governed AI can weaken institutional trust, even if systems are technically effective; conversely, well-governed AI can foster more credible, transparent, and sustainable forms of management transformation. Taken together, these governance challenges demonstrate that AI-enabled management is subject to a wide range of organizational and institutional conditions. Data governance, accountability, explainability, staff readiness, leadership, procurement, regulatory compliance, and trust all influence whether AI facilitates meaningful management transformation or generates new forms of opacity, fragmentation, and risk. This broader and more diverse literature reinforces the article's central argument: in healthcare organizations, AI does not become a sustainable management asset simply because it is implemented. It only becomes valuable when technological capabilities evolve alongside governance capacity, organizational design, and institutional legitimacy.

Sustainability Opportunities for Healthcare Organizations

In this section, sustainability is treated as a multidimensional management outcome. It includes the long-term ability of healthcare organizations to maintain effective operations, ensure continuity of service delivery, support workforce resilience, adapt to uncertainty, and preserve public trust while delivering quality care. WHO/Europe's framework for resilient and sustainable health systems emphasizes transformation, responsiveness, trust, and institutional adaptability in the face of demographic pressure, workforce shortages, and systemic stress (World Health Organization [WHO], 2024).

One major sustainability opportunity associated with AI is operational resilience. Healthcare organizations are expected to maintain quality while managing limited resources, rising demand, ageing populations, and complex patient journeys. OECD analysis of AI in the EU healthcare sector notes that AI may alleviate workforce shortages by automating administrative tasks, optimizing resource allocation, and supporting hospital operations, including planning, patient management, bed and staff coordination, and workflow efficiency (OECD, 2026a). WHO evidence similarly indicates that big data and AI can support predictive modelling,

patient-flow forecasting, resource allocation, and the performance of health and social care workers (WHO, 2025a).

A second important aspect concerns workforce resilience. The resilience of healthcare organizations depends significantly on whether leaders can protect professional capacity, reduce excessive administrative burdens, and support staff in the face of overload and burnout. OECD work on AI and the healthcare workforce notes that healthcare systems face increased demand, rising costs, and overburdened staff, and argues that AI can help alleviate some of this pressure, although its value depends on trust, ethics, skills, and infrastructure (Almyranti et al., 2024). Related OECD work on digital and AI skills in the health professions adds that stakeholders see AI's potential to improve productivity and mitigate workforce shortages, and also call for more effective communication, education, and specialized management structures (OECD, 2025a). More focused research in healthcare similarly suggests that generative and conversational AI can reduce the burden of documentation and free up staff time for more important interactions, provided implementation is careful and human-centered (Mahajan & Powell, 2025). Thus, AI can contribute to workforce resilience not by replacing human labor, but by redistributing tasks, expanding decision support, and helping organizations conserve scarce professional resources.

AI also creates opportunities to enhance institutional resilience, understood as preparedness, learning, and adaptive response. In resilient organizations, management systems do not only react to crises; they identify changes earlier, coordinate responses more quickly, and maintain operational continuity under pressure. Evidence from the NHS AI Lab evaluation illustrates this point: the programme supported infrastructure, policy, real-world deployment, and learning, while also revealing barriers related to procurement, integration with existing systems, and alignment with service needs (Cresswell et al., 2025). This example shows that resilience emerges through coordinated governance and policy ecosystems rather than through isolated tools alone.

Another opportunity relates to economic and value sustainability. Artificial intelligence is often associated with promises of efficiency, but from a management perspective, these promises are only meaningful if they translate into real value over time. A recent paper in NEJM AI argues that the sustainable use of AI in healthcare depends on organizational maturity in several areas, including governance, business implementation, value creation, maintenance and operations, and information architecture (Durlach et al., 2024). This is important because sustainability is viewed not as a vague benefit, but as an outcome linked to management capabilities

and long-term operational effectiveness. Additionally, a 2025 systematic review on the cost-effectiveness and budget impact of AI in health found that economic evaluation is essential, as health leaders and policymakers need to know whether AI interventions deliver sustainable benefits and represent good value for money in the context of rising health care costs (El Arab et al., 2025). In other words, AI can contribute to the sustainability of health organizations when it improves value creation, not simply when it adds technological complexity.

At the same time, sustainability gains are conditional. The WHO regional readiness assessment shows that AI is already changing planning, service delivery, and health-system management, while also highlighting gaps in preparedness, governance, skills, and institutional capacity (WHO, 2025a). OECD evidence on scaling AI in health further indicates that AI may already be widespread in administrative uses, yet national-level scale-up remains constrained by fragmented data foundations, regulatory uncertainty, and gaps in governance and workforce capacity (OECD, 2026b).

It is also important to recognize that sustainability should not be reduced to efficiency rhetoric. Emerging literature cautions the need to evaluate AI in medicine in terms of long-term viability, implementation costs, and broader systemic implications, including ethical, infrastructural, and even environmental aspects (Bignami et al., 2025; Fiske et al., 2025). This does not undermine the case for the sustainable development of AI; rather, it reinforces the need for a more rigorous and responsible interpretation of the concept of sustainability. From a management perspective, the relevant question is not whether AI is inherently sustainable, but under what institutional conditions it supports sustainable organizational value, equitable service delivery, and resilient forms of coordination. This understanding is particularly important for a sustainability-focused journal, as it links digital transformation to responsible innovation, not just technological enthusiasm.

Taken together, the literature suggests that AI can contribute to healthcare sustainability in four interrelated ways: operational sustainability through improved coordination and resource utilization; workforce sustainability through reduced burden and better task distribution; institutional sustainability through strategic alignment and governance maturity; and organizational resilience through stronger anticipation, learning, and continuity under stress. These effects remain contingent on governance mechanisms and organizational maturity.

Conceptual Framework

The preceding analysis supports a conceptual framework explaining how AI can contribute to sustainable organizational development in healthcare. The framework links AI resources and capabilities, governance conditions, management transformation processes, organizational outcomes, and sustainability outcomes. Its purpose is not to present a deterministic account of technological change, but to clarify the organizational conditions under which AI becomes a meaningful driver of management and institutional transformation (OECD, 2025b; Papagiannidis et al., 2025; WHO, 2025a).

At the first level, the framework defines AI resources and capabilities as a basic input layer. This includes not only the AI tools themselves but also the broader organizational resources that enable AI use: data availability and quality, digital infrastructure, analytical capabilities, implementation experience, and leadership commitment. The "AI for Healthcare Maturity Roadmap" is particularly relevant here, as it defines effective and sustainable AI implementation through interrelated areas such as governance, business adoption, value, maintenance and operations, culture, and information architecture (Durlach et al., 2024). Similarly, the WHO regional readiness assessment shows that AI adoption in health systems depends on institutional readiness, governance models, workforce readiness, and data management, not just technology availability (WHO, 2025a). This means that AI capabilities should be understood as organizationally embedded, rather than technically isolated.

The second level of the framework consists of governance conditions, which act as a central mediating layer between AI capabilities and organizational transformation. This part of the model draws on several complementary traditions. Papagiannidis et al. (2025) conceptualize responsible AI governance through structural, relational, and procedural practices, emphasizing that governance includes formal roles and policies, stakeholder relationships, and operational oversight processes. The NIST AI Risk Management Framework similarly views governance as a lifecycle function and positions it alongside mapping, measuring, and managing AI-related risks (National Institute of Standards and Technology [NIST], 2023). In healthcare, governance is further operationalized through implementation frameworks that emphasize review pathways, accountability mechanisms, inventory of AI systems, interdisciplinary oversight, and attention to people, processes, technology, and operations (Kim et al., 2025; Wells et al., 2025). Taken together, these sources suggest that the governance conditions in the proposed model should include at

least the following elements: data governance, accountability, transparency, leadership, workforce readiness, procurement capacity, and institutional oversight.

The third level of the framework is management transformation processes. This component reflects how AI is changing the way organizations are managed in practice. Based on the literature reviewed, AI-enabled transformation is most visible in strategic planning, operational coordination, resource allocation, performance monitoring, risk forecasting, and decision support (OECD, 2025b; Wells et al., 2025; WHO, 2025a). The key analytical point here is that AI does not simply improve individual management tasks; it changes the architecture of management, enabling more predictable, adaptive, and data-driven coordination modes. In the proposed framework, management transformation is viewed as a process layer through which AI resources become organizationally meaningful. This process is not automatic: it depends on how robust the governance conditions are for integrating AI into institutional procedures in a way that is verifiable, legitimate, and strategically coherent.

The fourth level concerns organizational outcomes. These are the most immediate consequences of AI-enabled management transformation in healthcare organizations. These may include increased efficiency, improved coordination, more timely decision-making, expanded monitoring capabilities, better alignment between planning and operations, and greater organizational agility. OECD research on AI-enabled management shows that robust implementation can improve responsiveness, productivity, and accountability in organizational and government settings, while healthcare-focused research suggests that practical governance can facilitate safer and more systematic implementation of AI in institutional activities (OECD, 2025b; Hassan et al., 2025; Wells et al., 2025). In the proposed model, such organizational outcomes are considered intermediate rather than final effects. They are important not because they represent success in themselves, but because they shape the organization's ability to function sustainably over time.

The final level of the model is sustainability outcomes. This model draws on the WHO/Europe framework for resilient and sustainable health systems, which emphasizes transformation, trust, adaptability, and long-term system capacity as central elements of future health governance (WHO, 2024). In this article, resilience is understood broadly to include operational, workforce, institutional, and organizational resilience. Artificial intelligence can contribute to these outcomes by strengthening anticipation, coordination, continuity, and adaptive capacity, but only if the earlier layers of this framework function in concert. This is consistent with

WHO and OECD evidence showing that the benefits of AI do not arise solely from its implementation; they depend on readiness, governance, capacity, and institutional alignment (OECD, 2025b; WHO, 2025a). Resilience is thus conceptualized as an indirect and contingent outcome of AI-enabled management transformation, rather than an automatic consequence of digitalization.

A key advantage of this framework is that it integrates organizational, managerial, and sustainability aspects into a single analytical logic. Many studies examine AI maturity, governance, implementation risks, workforce pressure, or resilience separately. In contrast, the proposed model explains how AI resources become organizationally meaningful through governance conditions; how governance shapes management transformation; how transformation produces intermediate organizational outcomes; and how these outcomes may support long-term sustainability.

The proposed conceptual model also has practical value for the argumentation of this article. This framework allows us to analyze healthcare organizations not simply as passive users of AI, but as institutions whose resilience depends on how they manage AI and integrate it into management practices. It also helps explain why the same technology can yield different results in different organizations: where governance is fragmented, data quality is low, or management capacity is weak, AI can generate opacity, dependency, or limited value; where governance is mature and strategically aligned, AI can facilitate more adaptive and resilient management. In this sense, the conceptual framework provides a theoretical bridge between the article's three research questions. It clarifies how AI is transforming management models, why governance challenges play a central role in this process, and under what conditions resilience and sustainability outcomes are possible in healthcare organizations.

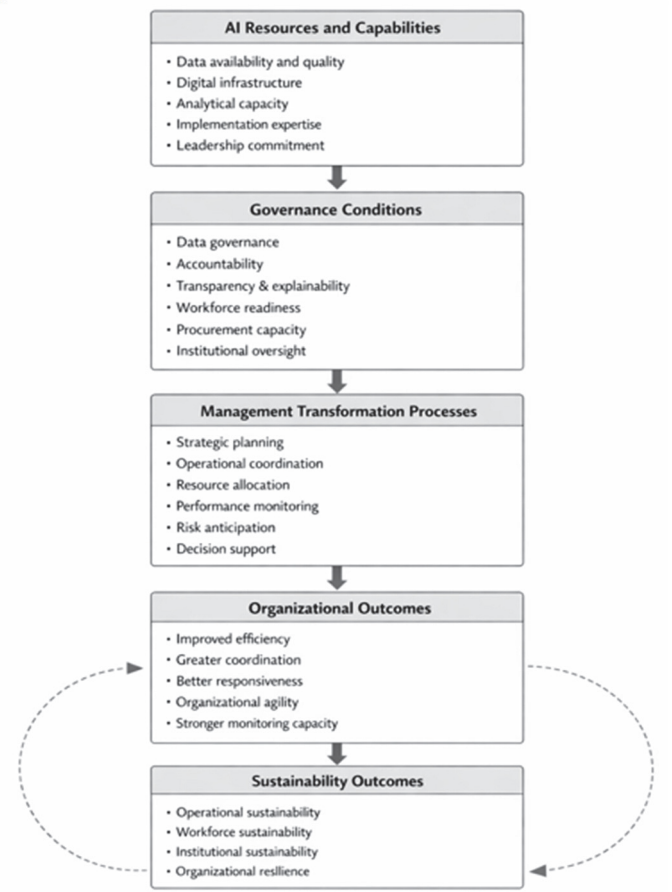
For the purposes of this article, the proposed framework can be represented as a five-stage sequence (see fig.1.):

- ✓ AI Resources and Capabilities.
- ✓ Governance Conditions.
- ✓ Management Transformation Processes.
- ✓ Organizational Outcomes.
- ✓ Sustainability Outcomes.

In empirical reality, this sequence should not be interpreted as strictly linear. In practice, feedback loops are likely to emerge: organizational outcomes may alter management mechanisms, and sustainability pressures may influence future capacity development. Nevertheless, as an analytical tool, this framework provides a holistic framework for examining AI as a

driver of management transformation in healthcare organizations. Therefore, it serves as a central interpretive model for the subsequent discussion.

Figure 1 - Conceptual framework of AI-enabled transformation of management models in healthcare organizations



Source: Developed by the authors based on the reviewed literature; visual drafting was supported by ChatGPT image tools.

Discussion

The analysis confirms that the organizational significance of AI in healthcare lies in its capacity to reshape planning, coordination, monitoring, and adaptation processes. This perspective complements clinical and

technical discussions by positioning AI as a management issue: its impact depends on how organizations redesign decision-making routines, oversight mechanisms, and operational workflows (OECD, 2025b; Papagiannidis et al., 2025; WHO, 2025a).

The central finding is that governance operates as a mediating layer between AI capabilities and sustainable organizational outcomes. AI can improve forecasting, coordination, and decision support, but its value depends on accountability, transparency, workforce readiness, data management, procurement capacity, and lifecycle control. This confirms a broader trend in recent governance research: the key issue is no longer only whether AI can be implemented, but under what institutional conditions it can be implemented responsibly, coherently, and with long-term value (NIST, 2023; Wells et al., 2025; WHO, 2025a).

The discussion also suggests that AI-enabled management transformation should be understood as a socio-technical, rather than purely digital, process. This is an important conceptual point. AI does not automatically create more intelligent or more efficient organizations; instead, AI changes the way management knowledge is generated, interpreted, and applied. Such changes require not only infrastructure and data, but also leadership commitment, organizational learning, process redesign, and institutional capacity to implement new forms of decision support. Thus, the conceptual framework proposed in this article helps explain why organizations with similar technologies can experience vastly different outcomes: transformation depends not so much on the mere presence of AI as on the maturity of the governance and management environment. This interpretation is largely consistent with recent maturity and adoption frameworks in healthcare, which emphasize culture, governance, business embedding, maintenance, and operational integration, rather than just technical deployment (Durlach et al., 2024; Kim et al., 2025).

Table 1 - Governance challenges and sustainability opportunities of AI-enabled management

Governance challenge	*Organizational risk if unaddressed*	*Sustainability opportunity if addressed*
Data governance	Poor data quality, fragmented decision-making, unreliable forecasting	More accurate planning, stronger operational sustainability, improved trust in AI-supported management
Accountability and oversight	Unclear responsibility for AI-assisted decisions, weak control over errors and unintended effects	More reliable governance, stronger institutional legitimacy, safer long-term implementation

Transparency and explainability	Reduced trust, difficulty justifying managerial decisions, opaque operational processes	Greater organizational trust, improved interpretability of decisions, stronger legitimacy of AI use
Workforce readiness	Misuse of AI tools, overreliance on automated outputs, implementation resistance	Better task integration, stronger workforce sustainability, more informed and adaptive management
Leadership and organizational design	Fragmented implementation, weak strategic alignment, inconsistent governance practices	More coherent transformation, stronger institutional sustainability, better coordination across units
Procurement and implementation pathways	Adoption of poorly matched or weakly governed systems, vendor dependency, mission drift	More sustainable technology adoption, improved strategic fit, better long-term value creation
Regulatory alignment	Compliance gaps, legal uncertainty, inconsistent implementation standards	Greater institutional stability, improved accountability, stronger external legitimacy
Trust and stakeholder engagement	Staff resistance, reduced public confidence, weak organizational acceptance	Stronger legitimacy, better adoption, more resilient and socially acceptable management transformation

Source: Developed by the authors based on the reviewed literature.

Table 1 summarizes the key governance challenges associated with the use of AI and shows how addressing these challenges can create opportunities for sustainable development in healthcare organizations.

To respond to the need for stronger empirical grounding, Table 2 adds selected real-world examples and data signals that support the framework. These examples do not turn the article into an empirical study; rather, they demonstrate that the proposed relationships are consistent with implementation evidence from health systems, policy evaluations, workforce data, and organizational governance cases.

The evidence summarized in Table 2 strengthens the conceptual argument in two ways. First, it shows that governance challenges are not abstract ethical concerns but practical barriers observed in real-world implementation, including procurement, workforce capability, data foundations, and scalability. Second, it demonstrates that sustainability outcomes depend on organizational maturity: AI creates value when

institutions can translate data and algorithms into coordinated management routines, review processes, and accountable decision-making.

Table 2 - Real-world implementation evidence supporting the proposed framework

Evidence / case	Key empirical or practical signal	Implication for AI-enabled management
WHO/Europe AI readiness survey (2024-2025)	The survey drew on insights from 50 Member States and examined national strategies, governance models, legal and ethical frameworks, workforce readiness, data governance, stakeholder engagement, and AI uptake (WHO, 2025a).	AI is already affecting how care is planned, delivered, and governed, but organizational benefits depend on readiness and governance capacity.
OECD digital and AI skills evidence	Analysis of nearly 55.5 million online job postings in Canada, the United Kingdom, and the United States tracked demand for digital and AI skills in health-related occupations from 2018 to 2023 (OECD, 2025a).	Workforce readiness is not a secondary issue; it is a core condition for sustainable AI adoption and for preventing implementation gaps.
OECD evidence on scaling AI in health	OECD (2026b) reports that AI is widely used in administration across member countries, while national-level scaling remains constrained by fragmented data foundations, regulatory uncertainty, and governance and workforce-capacity gaps.	Sustainability depends on moving from isolated use cases to scalable governance, shared objectives, and trustworthy deployment mechanisms.
NHS AI Lab evaluation	The NHS AI Lab evaluation identified progress in infrastructure, policy, and real-world deployment, but also barriers connected with procurement, integration into existing infrastructures, and alignment with service needs (Cresswell et al., 2025).	AI-enabled resilience requires system-level coordination, not only technically successful tools.

Evidence / case	Key empirical or practical signal	Implication for AI-enabled management
Canadian healthcare AI governance case	A healthcare delivery organization case study shows how governance can be structured through people, processes, technology, and operations (Kim et al., 2025).	The proposed governance layer is operationally realistic: it can be translated into committees, review pathways, system inventories, and lifecycle oversight.

Source: Developed by the authors based on WHO (2025a), OECD (2025a, 2026b), Cresswell et al. (2025), and Kim et al. (2025).

Another important implication concerns the relationship between AI and sustainability. Sustainable development should not be treated as an automatic byproduct of digital innovation. Instead, it should be understood as a contingent outcome of AI-enabled management transformation. AI may contribute to operational, workforce, institutional, and organizational resilience, but only when implementation is strategic, governed, and supported by learning-oriented institutions (OECD, 2025b; WHO, 2024; WHO, 2025a).

From a practical perspective, the article points to several implications for healthcare leaders and managers. First, AI implementation should be viewed as a management and governance project, not an isolated procurement or IT initiative. Second, institutions need to create cross-functional governance structures that integrate leadership, technical expertise, legal expertise, operations, and end-user perspectives. Third, organizational value should be assessed not only in terms of immediate effectiveness but also in terms of long-term adaptability, staff support, trust, and continuity. Recent real-world research on managing and scaling AI in healthcare supports this view, demonstrating that enterprise-level AI requires formal governance, risk mitigation pathways, model oversight, and alignment between implementation goals and institutional objectives. These findings suggest that the managerial challenge lies not simply in implementing AI, but in managing it as part of a coherent transformation strategy (Bodnari et al., 2025; Cresswell et al., 2025; Wells et al., 2025).

The article also has implications for policy and research. At the policy level, the findings support the argument that government agencies and healthcare institutions need implementation-focused governance frameworks, not just abstract principles. Regulatory discussions, including the burgeoning debates around the Artificial Intelligence Act and industry oversight, increasingly recognize the need to translate compliance into operational procedures, review structures, and institutional accountability.

At the research level, this study suggests that future research should pay greater attention to AI as a driver of organizational transformation, rather than limiting analysis to clinical effectiveness or narrow ethical issues. In particular, further research is needed on how artificial intelligence influences managerial authority, organizational learning, interdepartmental coordination, and resilience under uncertainty. Such a research program would help to integrate existing disparate research on digital transformation, healthcare management, and sustainability (OECD, 2025b; Vardas et al., 2025; WHO, 2025a).

Several limitations should be acknowledged. Because the study is based on a structured analytical review rather than primary empirical data, the proposed framework remains conceptual and interpretive. The additional real-world examples included in the discussion strengthen practical grounding but do not replace organization-level testing. Future research should therefore examine how specific governance conditions influence AI adoption, management transformation, and sustainability outcomes across different healthcare contexts.

Overall, the discussion reinforces the article's central thesis: AI should be understood as a driver of management transformation, with organizational effects dependent on governance capacity and long-term value expressed through sustainability and resilience outcomes. Healthcare organizations are particularly useful for demonstrating this argument, as they combine high management complexity, strong institutional constraints, and clear expectations of societal value. Therefore, the use of AI in healthcare is not simply a question of technology but also a question of how organizations manage complex systems, distribute responsibility, and maintain effective management in the face of change (OECD, 2025b; WHO, 2025a; Wells et al., 2025).

Conclusions

This article argues that artificial intelligence should be understood as an organizational capability that can transform management models in healthcare organizations under specific governance conditions. The analysis shows that AI affects strategic planning, operational coordination, resource allocation, performance monitoring, and decision support, thereby changing how healthcare organizations manage complexity and sustain performance over time.

The central finding is that the organizational effects of AI are conditional. AI does not automatically produce better governance,

efficiency, or resilience. Its value depends on data management, accountability, transparency, workforce readiness, leadership capacity, procurement competence, and institutional oversight. Governance therefore acts as the layer that determines whether AI becomes a meaningful organizational asset or a source of opacity, fragmentation, and institutional risk.

The article also demonstrates that AI-enabled transformation should be viewed as a socio-technical process, not a purely digital one. AI implementation requires not only technological infrastructure and information resources, but also organizational learning, adaptation of management processes, and strategic alignment. This perspective helps explain why similar AI tools can yield different results in different organizations: results depend not so much on the mere presence of AI as on the maturity of the institutional and management environment in which it is implemented.

Another important finding concerns the relationship between AI and sustainability. Sustainability in healthcare should be understood as operational continuity, workforce resilience, institutional adaptability, responsible resource use, and long-term organizational viability. AI can support these outcomes through better forecasting, coordination, responsiveness, and resource allocation, but only when implementation is coherent, accountable, and aligned with institutional goals.

The conceptual framework proposed in this article provides a synthetic explanation of these relationships, linking AI resources and capabilities, governance conditions, management transformation processes, organizational outcomes, and sustainability outcomes. This model contributes to the literature by integrating insights from governance research, management studies, digital transformation research, and health systems analysis into a single interpretive framework. Thus, it offers a more comprehensive way to understand AI in healthcare organizations than approaches limited to clinical effectiveness or isolated ethical concerns.

From a practical perspective, the article suggests that healthcare leaders should approach AI implementation as a strategic management objective, rather than a narrowly technical or procurement issue. Institutions seeking to reap sustainable benefits from AI must invest not only in technology but also in governance mechanisms, staff skills, cross-functional coordination, and review processes that ensure accountability and long-term institutional compatibility. For policymakers, the findings support the need to transform regulatory principles into implementation-oriented governance structures that can support robust and sustainable implementation in real-world organizational settings.

The study also has limitations. As a theoretical and analytical article based on a structured literature review, it does not empirically test the proposed relationships in specific healthcare organizations. Future research should therefore examine the framework through comparative case studies, surveys of healthcare managers, and mixed-method evaluations of AI governance practices in public and private healthcare institutions.

Overall, the article concludes that AI can become a significant driver of governance and management transformation in healthcare organizations when technological capabilities are matched with institutional readiness, responsible governance, and long-term sustainability objectives. Its value lies not in automation alone, but in its capacity to support more adaptive, coordinated, accountable, and resilient management models.

Declaration on the Use of Artificial Intelligence

During the preparation of this manuscript, the authors used AI-based tools, for language polishing, stylistic editing, reduction of textual repetition, improvement of argumentative clarity, and support in the visual presentation of the conceptual framework. Figure 1. was developed by the authors based on the reviewed literature; visual drafting was supported by ChatGPT image tools. These tools were not used to generate research data, conduct autonomous analysis, replace scholarly judgment, or make final interpretive decisions. No patient data or confidential institutional data were processed through AI tools. All AI-assisted outputs were critically reviewed, verified, edited, and approved by the authors, who take full responsibility for the accuracy, integrity, originality, and content of the submitted manuscript.

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Human Capital Performance Beyond the Standard: Parenting and New Sustainability Indicators in the Banking Sector

by *Alessandra Bianchi*[*]*, Ilaria Magni*[^]

Abstract
This study examines the use of innovative Social Key Performance Indicators in the sustainability disclosure of an Italian Banking Group. Moving beyond compliance, can provide evidence of tangible corporate welfare and societal change. New metrics will be introduced gradually. Firstly, the number of newborns, will be assessed. The goal is to optimize business strategy, enabling organizations to refine their approaches based on real-time impact data and creating medium to long-term policies, aligning the new indicator with existing KPIs that shift the focus from the time of birth alone to effective support. The "Methodology for Standardized and Accountable Aggregation of HR-Derived Sustainability Data" has been defined to transform entity-level HR input into a comparable and auditable ESG KPI (newborn), ensuring consistency across the Group despite non-consolidated data generation. This study highlights how the use of the KPI "Newborn" strengthens accountability and transparency, providing evidence for stakeholders regarding the effectiveness of social initiatives.
Keywords: Key Performance Indicators, CSRD, Social Sustainability Standards, Corporate Social Responsibility, human capital, banking group

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1. Introduction

In recent years, the debate on social sustainability has progressively

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shifted its focus from the dimension of motherhood[1] to the broader and more inclusive concept of parenthood. This evolution reflects a cultural change that recognizes care as a shared responsibility among parents with significant implications for gender equality, workforce participation, and organizational well-being. In this context, there is a growing need for measurement tools capable of representing the "birth" experience within organizations in a more comprehensive and unbiased way.

The ESRS standards represent the primary reference framework for structured, comparable, and materiality-oriented sustainability reporting. The "core" KPIs envisaged by the framework allow to monitor key aspects such as employment, diversity, training and health and safety, ensuring transparency towards stakeholders, investors, and supervisory authorities. However, due to their standardized nature, these indicators do not always fully capture the complexity of the human and relational dimension that characterizes corporate life.

From this perspective, the Mediocredito Centrale Banking Group[2] (hereinafter also the "Group" or "MCC") has chosen to introduce complementary KPIs, such as the "Newborn" indicator, assigning it not only a measurement function but, above all, a cultural and strategic value.

In a context evidenced by demographic transformations, evolving workplace expectations and increasing attention to work-life balance, these indicators enable the identification of emerging needs and support a proactive and data-driven HR approach. They also help highlight phenomena that are often not captured by traditional KPIs – such as challenges in post-leave returns, unequal use of work-life balance measures, risks of talent attrition – thus enabling a more informed dialogue with Senior Management and more conscious strategic decision-making.

Complementary KPIs do not replace standard disclosures; rather, they enhance them by strengthening the organization's ability to monitor and manage relevant social issues. The data is used not only to activate immediate support measures but also to guide structural policies in the areas of welfare, work organization, development, and inclusion.

When analyzed over time and integrated with other indicators, this KPI allows to observe post-birth dynamics – such as quality of return to work,

[1] Italian Constitution (Article 37) guarantees special adequate protection for mothers and children.

[2] Mediocredito Centrale, within the Invitalia Group, is a banking group with an institutional role aimed at enhancing the country's competitiveness, particularly in Southern Italy. In December 2025, Artigiancassa became part of the Mediocredito Centrale Group; therefore, the data included in the sustainability reporting refers to the stock data as of 31 December 2025 and does not include the full 2025 flows.

retention, career paths, distribution of care responsibilities, and engagement – thus becoming a lever to understand broader organizational phenomena. From this perspective, measurement emerges as a tool for cultural transformation and strategic planning, consistent with the Group's Purpose: to create lasting value by placing people and their well-being at the center throughout the entire working life cycle.

2. Background

The first step of the research was the analysis of the state of the art of the use of complementary KPIs and the use of the "newborn" metric, examining the scientific literature on three specific themes:

- history and evolution of social KPIs and definitions;
- regulatory framework;
- research gaps and innovation.

This first phase of investigation pointed out that the newborn KPI is widely used in the medical field or for demographic and economic sustainability analysis. but not, as extensively, in other contexts. This review highlights a gap in published literature on the use of this metric in relation to corporate welfare for the creation of medium to long term strategies.

2.1 History and evolution of social KPIs and definitions

The concept of KPI dates back to the early 20th century when Frederick W. Taylor[3], a pioneer in scientific management, introduced the idea of using data and measurement to improve productivity and efficiency in industrial settings. Taylor emphasized the importance of defining standards and measuring performance against those standards.

In the 1950s and 1960s, Drucker's MBO approach influenced the development of KPIs as a means to measure performance against predetermined objectives. However, the term "Key Performance Indicator" was introduced later, in the late 1970's and early 1980's, thanks to the works of pioneers such as J. F. Rockart, D. Otley, E.D. Chow (1979-1982).[4]

[3] Taylor, F. W. (1911). *The Principles of Scientific Management*. New York: Harper & Brothers.

[4] Rockart, J.F. (1979). Chief executives define their own data needs. *Harvard business review*, 57(2); Otley D. T., 1980 The contingency theory of management accounting: Achievement and prognosis; Chow, E. D. (1982). Developing Key Performance Indicators for Organizational Success. *Journal of Business Strategy*.

Over time, the use of KPIs evolved as advanced management practices. In the mid-20th century, management theories such as Total Quality Management (TQM) and the Balanced Scorecard further contributed to the development and adoption of KPIs.

TQM, popularized by management thinkers like W. Edwards Deming and Joseph Juran,[5] emphasized continuous improvement and customer satisfaction. It introduced the concept of statistical process control and performance metrics to ensure consistency and improve quality.

Kaplan and Nolan's approach allowed businesses to move beyond traditional financial metrics, incorporating KPIs that measured customer satisfaction, internal processes, learning and growth, through the Balanced scorecard.[6] A framework that emphasizes the importance of linking performance measures to an organization's strategic objectives and that *"translates an organization's vision and strategy into a coherent set of performance measures"* (Kaplan and Nolan, 1992).

Later, in 2002, Paul Niven played a crucial role in advocating for the use of KPIs at all organizational levels, particularly in the public and nonprofit sectors. In his 2002 book, "Balanced Scorecard: Step-by-Step for Government and Nonprofit Agencies," Niven emphasized that KPIs should be adapted to fit different organizational contexts, including at the department and individual levels.

Bernard Marr, in 2012, gave a definition of KPIs stating that they provide a way to measure how well companies, business units, projects or individuals are performing in relation to their strategic goals and objectives. He elevated KPI use in Data Strategy and Performance Management, translating complex business concepts into actionable insights, helping businesses of all sizes understand how to use KPIs effectively to drive performance at every level.[7]

According to Clifton[8] (2012), a KPI can be defined as any measure, percentage, index or average that can help an organization to quickly understand incoming data in the right context and time. He highlights their use to communicate critical, high-impact information to senior management to drive strategic change.

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[5] Deming, William E. *Quality, Productivity, & Competitive Position*, Massachusetts Institute of Technology; c1982. 373p. Deming, William E. *Out of the Crisis*. 5th ed., Massachusetts Institute of Technology; 1982. 507p. Juran, Joseph M., Gryna, Frank M. *Quality Control Handbook*. 4th Edition ed., McGraw-Hill; 1988. 1600p.

[6] Kaplan, Robert S., and David Norton. The Balanced Scorecard: Measures that Drive Performance. *Harvard Business Review*, (January-February 1992), 70(1): 71-79. (Reprint #92105.).

[7] Marr, B. (2012). *Key Performance Indicators (KPI): The 75 measures every manager needs to know*. Pearson Education Limited, Financial Time Series.

[8] Clifton B. (2012). *Advanced Web Metrics with Google Analytics*. John Wiley & Sons.

A definition of KPI that can be found in the ISO 22400-1 of 2014,[9] that defines them as a "quantifiable level of achieving a critical objective", to establish a common language for performance metrics, enabling the comparison of operations across different industries and time periods. The standard, though, provides a framework, but does not dictate how to set targets, manage improvement programs, or select which KPIs are most relevant to a specific organization. Moreover, is heavily focused on production execution, often overlooking strategic level.

Today, KPIs are widely used across industries and organizations of all sizes. They are customized based on the specific objectives and priorities of each organization and play a crucial role in performance management, strategy execution, and decision-making. With the increasing availability of data and technology, organizations can collect, analyze, and monitor KPIs in real-time, enabling more informed and proactive decision-making.[10]

The KPIs related to social issues, can be first dated to the mid-1960s, when the "social indicators movement" was born as a reaction against an over- emphasis on measures of economic performance as indicative of social well-being. Social Indicators can be defined as measures of an observable trait of a social phenomenon, which help to establish the value of a different unobservable trait of the phenomenon[11]. They serve as essential surrogates for, or proxies of, abstract, unmeasurable social concepts, allowing the quantification and analysis of complex societal phenomena. Translating concepts like "equity" or "social sustainability" into observable, operational terms (e.g., life expectancy and health, gender pay gap, access to basic services or digital inclusion), can provide measures for society.

The best way to collect societal data is the use of a combined method that considers both quantitative and qualitative data, surveys, statistics or interviews and focus groups. By combining the strengths of both methodologies, researchers can triangulate data, validate findings, and gain deeper insights into research questions (Ahmed, Pereira, & Jane, 2023).

As Raymond Bauer stated, the use of sample surveys to collect a greater variety of basic social statistic, will enable us to plot trends, to measure progress toward the attainment of social goals and values.[12]

The concept and use of Key Performance Indicators related to societal issues have evolved from a narrow focus on internal organizational

[9] https://www.iso.org/obp/ui/es/#iso:std:iso:22400:-1:ed-1:v1:en:term:2.1.1.
[10] KPIs are evolving with AI, turning static metrics into predictive tools for stakeholders.
[11] Michael Carley & Eduardo Bustelo (1986). Social indicators and development. *Project Appraisal*, 1(4): 266-268, DOI: 10.1080/02688867.1986.9726580.
[12] Bauer R.A. (1966). Social Indicators and Sample Surveys. *Public Opinion Quarterly*, Fall, 30(3): 339-352, DOI: 10.1086/267428.

efficiency and financial metrics in the early 20th century to a comprehensive, data-driven approach that measures broader impact on people, communities, and sustainability in the 21st century. This evolution reflects a shift from viewing societal impact as a secondary concern to a core strategic imperative integrated into corporate governance, investments, and public policy (Table 1).

The above-mentioned evolution is linked to strict regulatory requirements, such as the EU Corporate Sustainability Reporting Directive (CSRD)[13]. Societal KPIs have shifted from voluntary, high-level tracking to rigorous, audited, and standardized metrics integrated into core business strategy. The focus has moved from measuring activities to outcomes, starting from the double materiality assessment to identify the most relevant social topics for the Organization, requiring data integrity and integration.[14]

Changes in Societal KPIs

Attribute	*Previous Approach*	*Contemporary Approach*
Focus	Financial & Operational	Social, Environmental, Governance (ESG)
Goal	Profit & Productivity	Impact, Sustainability, Value Creation
Perspective	Internal	Stakeholder-Centric
Data Type	Lagging (Past performance)	Real-time & Predictive (Future-focused)
Usage	Executive Level Reporting	Integrated into Strategy & Incentives

Table 1 - Changes, in time and by attribute, on how societal Kpis are approached. Table elaborated by the authors based on information from Taylor, F. W. (1911), Bowen, H. R. (1953), Kaplan, R. S., & Norton, D. P. (1992), Porter, M. E., & Kramer, M. R. (2011), CSRD and EFRAG ESRS Standards

[13] CSRD: Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (Text with EEA relevance); Omnibus I: Directive (EU) 2026/470 of the European Parliament and of the Council of 24 February 2026 amending Directives 2006/43/EC, 2013/34/EU, (EU) 2022/2464 and (EU) 2024/1760 as regards certain corporate sustainability reporting requirements and certain corporate sustainability due diligence requirements (Text with EEA relevance).

[14] Companies subject to the CSRD have to report according to European Sustainability Reporting Standards (ESRS) developed by EFRAG. Core Societal KPIs under CSRD (ESRS S1-S4). Own Workforce (ESRS S1): Workers in the Value Chain (ESRS S2): Affected Communities (ESRS S3): Consumers/End-users (ESRS S4):

2.2 Regulatory framework

KPIs are no longer merely internal management tools; they become legal requirements when used to ensure transparency toward stakeholders or compliance with quality standards and regulations.

The regulatory background defines standardized and audited sustainability disclosure and is principally driven by European legislation but also by global investors and customers' pressure.

The origins were based on Voluntary Initiatives and International Standards (1990s-2013). In the 90s: The first "social reports" or sustainability reports emerge on a voluntary basis. In 1997: The Global Reporting Initiative (GRI) is founded, introducing the first international standards for sustainability reporting.

In 2014, with the Directive 2014/95/EU (NFRD - Non-Financial Reporting Directive), the European Union introduces the obligation to disclose non-financial information for large public-interest entities (banks, insurance companies, listed companies) with more than 500 employees to increase transparency on environmental and social issues, human resources management, human rights, and the fight against corruption.

Italy transposed the NFRD[15], making the "Non-Financial Statement" (DNF) mandatory as of January 1, 2017.

The European Union replaced the Non-Financial Reporting Directive (NFRD) with the Corporate Sustainability Reporting Directive (CSRD) in 2023.[16] , going beyond the NFRD. In fact, the obligation is extended to many more companies (including listed SMEs), it introduces more detailed reporting standards (ESRS), and requires mandatory audit.

The regulation shifts from mere reporting to actual management obligations regarding sustainability.

To implement the CSRD, the European Commission adopted the first European Sustainability Reporting Standards (ESRS) in July 2023.

These standards define what and how companies must report, eliminating the fragmentation of previous frameworks (there is a transition from voluntary GRI to mandatory ESRS).

The Four Key Social Standards (ESRS S1-S4)[17] developed by EFRAG are the following:

[15] Legislative Decree No. 254 of December 30, 2016.
[16] CSRD - EU Directive 2022/2464).
[17] www.efrag.org.

ESRS S1 Own Workforce: Covers working conditions, equal opportunity, and other work-related rights for employees and non-employee workers.

ESRS S2 Workers in the Value Chain: Addresses human rights, working conditions, and safety of workers within the company's upstream and downstream value chain.

ESRS S3 Affected Communities: Focuses on the impacts on local communities, including human rights and environmental impacts.

ESRS S4 Consumers and End-Users: Addresses the health, safety, privacy and rights of consumers and end-user.

The double materiality requirement is introduced to analyze both the company's impact on the external environment (inside-out) and how sustainability factors influence the company itself (outside-in).

Italy officially transposed the CSRD into national law through Legislative Decree No. 125 of September 6, 2024. The "Sustainability Report," must be included in the Management Report of the financial statements and a third-party assurance has to certify the compliance.

Following that, with the Omnibus package[18], that entered into force on March 18, 2026 the CSRD was revised[19]. The package has drastically reduced the number of companies required to disclose non-financial information. The reporting requirement now applies only to companies with more than 1,000 employees, while the previous threshold was of 250 and net revenue exceeding 450 million euros. For unlisted SMEs that choose to report voluntarily, the Voluntary Standard for micro, small and medium-sized undertakings[20] has been introduced – a simplified framework based on a basic or comprehensive module.

[18] Directive (EU) 2026/470 of the European Parliament and of the Council of 24 February 2026 amending Directives 2006/43/EC, 2013/34/EU, (EU) 2022/2464 and (EU) 2024/1760 as regards certain corporate sustainability reporting requirements and certain corporate sustainability due diligence requirement.

[19] EU Member States must transpose the amendments to the CSRD by March 19, 2027.

[20] VSME Standard is published by EFRAG with the aim of supporting micro-, small- and medium-sized undertakings in: (a) providing information that will help satisfy the data needs of large undertakings requesting sustainability information from their suppliers; (b) providing information that will help satisfy data needs from banks and investors, therefore helping undertakings in their access to finance; (c) improving the management of the sustainability issues they face, i.e. environmental and social challenges such as pollution, workforce health and safety. This will support their competitive growth and enhance their resilience in the short-, medium- and long-term; and (d) contributing to a more sustainable and inclusive economy. www.efrag.org.

Substantial contribution to the main legal requirements involving sustainable activities in finance, is given by the EU Taxonomy Regulation (EU 2020/852) and the SFDR (Sustainable Finance Disclosure Regulation)[21].

The EU Taxonomy is a classification system that defines criteria for economic activities that are aligned with a net zero trajectory by 2050 and the broader environmental goals other than climate.[22] It defines mandatory KPIs for financial and non-financial firms, specifically regarding the percentage of revenue, CapEx and OpEx aligned with the environmental taxonomy[23].

The Sustainable Finance Disclosure Regulation requires specific KPIs for financial products that promote environmental or social features.

Within the legal framework, ISO standards deserve a mention as structured tools for advancing sustainability by providing frameworks that balance environmental, social, and economic needs.[24]

They provide practical solutions for businesses and organizations to align with their sustainability goals and suggest the use of Key Performance Indicators to measure process effectiveness, monitor risk, and drive continuous improvement

KPIs for ISO Standards, translate strategy into actionable targets bridging the gap between high-level sustainability policy and day-to-day operations.

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[21] Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector and Consolidated text: Regulation (Eu) 2023/2869 of the European Parliament and of the Council of 13 December 2023. http://data.europa.eu/eli/reg/2019/2088/2024-01-0.

[22] https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en.

[23] The mandatory KPIs for financial and non-financial firms regarding alignment with the environmental taxonomy are defined under Article 8 of the Taxonomy Regulation (EU 2020/852) and further specified by the Disclosures Delegated Act (Commission Delegated Regulation (EU) 2021/2178). Non-Financial Undertakings must report the proportion of turnover, CapEx, and OpEx aligned with the environmental taxonomy, while Financial Undertakings Must report KPIs that reflect the alignment of their investments.

[24] A non-exhaustive, illustrative list of key ISO Standards regarding sustainability includes: ISO 14001 Environmental Management System; ISO 50001 Energy Management. Enhances energy performance and efficiency; ISO 37101 Sustainable Development in Communities.; ISO 20400 Sustainable Procurement (Supply Chain Sustainability); ISO 14068 Net Zero. Guides businesses in achieving carbon neutrality; ISO 26000 Social Responsibility; ISO 45001Occupational Health & Safety. Improves workplace safety, reducing accidents and improving employee morale; ISO 46001Water Efficiency.; ISO 14040/14044 Life Cycle Assessment. Evaluates the environmental impact of products throughout their lifecycle; ISO 30415Diversity and Inclusion. Sets framework for diversity in organizations.

2.3 Research gaps and innovation

In business analysis, the KPI related to the number of newborns acts as a leading indicator for assessing future growth, financial sustainability, and market opportunities.

The World Bank uses newborn-related key performance indicators to monitor global health status, assess the effectiveness of its funding, and guide investments in national health systems.[25] These KPIs are integrated into the Results Framework of each project[26]

The number of newborns has been used as a KPI in the context of corporate welfare in two ways:

a) in a symbolic and communicative to measure "social well-being" and the impact of work-life balance policies. In this framework, the metric serves aa a social impact indicator, employer branding and talent attraction, welfare economic planning.
b) for incentives mechanisms connected to social and environmental targets.

Growing regulatory and investor pressure towards creating value for stakeholders has driven an evolution in incentive mechanisms, which in the past were linked exclusively to economic and financial objectives (Connelly et al., 2011). Companies have therefore begun to integrate social and environmental objectives into their compensation systems to align managerial decisions with corporate strategy and promote the pursuance of sustainable success (Maas and Rosendaal, 2016). ESG KPIs generally linked to the variable component of compensation systems serve as a mechanism to align management's actions with the interests of the company and its various stakeholders (including shareholders). From this perspective, the variable component of compensation is designed to align top management's behavior with the company's strategic priorities (Zattoni, 2020).

The prominent role of social KPIs is also asserted by a study conducted by Luiss University on Corporate Governance and Sustainability[27]. According to this research, 48% of large Italian listed companies link their KPIs to Diversity & Inclusion (DE&I), as shown in the following table elaborated by the authors (table 2):

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[25] Results Briefs September 5, 2024, Healthy Mothers and Babies: Supporting Skilled Attendance at Birth, World Bank Group, www.worldbank.org.

[26] Measuring and reporting results in the World Bank – An overview, World Bank Group https://www.worldbank.org/results.

27 Progetto GOST Sustainability Governance in Large Italian Listed Companies: Results and Implications for Listed Firms, edited by Marco Minciullo and Alessandro Zattoni, Egea Milano 2026.

KPI	*% of total companies*
DE&I	48%
Emissions	40%
Sustainability-related indices and financial products	35%
Energy transition	35%
ESG strategies and goals	30%
Health and Safety	28%
People	22.5%
Policy & compliance	18%
Stakeholder engagement	10%
Customer satisfaction	7.5%
Circular economy	7.5%

Table 2 - Minciullo M. and Zattoni A. Corporate Governance and Sustainability, Egea Milano 2026, page 12

As the table shows, the KPIs are linked, once again, to remuneration systems.

Other Banking groups have used the KPI new born to determine the size of the welfare budget – specifically from an HR perspective – but without using it as a complementary KPI in its reporting.

Intesa Sanpaolo Banking Group has incorporated specific measures such as "maternity packages" and childbirth grants into its welfare plan. Monitoring the number of employees who utilize these services is a key KPI for determining the size of the welfare budget.[28].

UniCredit Banking Group uses KPIs related to employees' children to manage the distribution of financial benefits, such as the "Riparto" Project: in 2025, new benefits for mothers returning from maternity leave were introduced, including a €1,000 voucher for childcare or allowances for dependent children, which in 2025/2026 will include tax-exempt thresholds of up to €2,000 for parents.[29]

BBVA has developed tools such as the "Baby Planner" which, although designed for customers, reflects a corporate culture that uses birth rate data

[28] See Intesa Sanpaolo Welfare Plan and Business Plan 2022-2025.
[29] Unicredit Banking Group Sustainability Report 2025.

to plan financial and welfare services specifically tailored to the "work-child" balance[30].

In MCC, the materiality of social aspects is determined by the double materiality analysis executed in accordance with the requirements of the CSRD to identify the topics to be disclosed both in terms of impacts generated on people and in relation to risks and opportunities for the Group.[31], The "Newborn" KPI was introduced in the 2025 Sustainability Report and disclosed for the first time within the new CSRD framework (paragraph S-1 Own Workforce).

The innovative element of this indicator lies in moving beyond an exclusively administrative or short-term perspective, traditionally limited to the sizing of welfare budgets or the contingent management of absences related to parenthood. At MCC, the KPI is used as an advanced tool for organizational analysis and strategic orientation, capable of capturing cultural and social transformations that affect the relationship between people and work. These include the evolving value attributed to work-life balance, the need for stability and economic security influencing family choices, the increasing interchangeability of parental roles, the enhancement of female talent and the evolution of expectations towards a more inclusive and sustainable corporate welfare system.

When read in association with additional indicators – such as the post-leave return rate or the gender pay gap among new parents – the KPI enables the development of a medium to long-term perspective. This approach permits to convert a demographic figure into a planning lever, effective in the designing of structural policies, in aligning HR initiatives with the objectives of the business plan and in anticipating potential social and organizational risks.

The indicator contributes to provide an overview of the Group's social well-being that is not limited to a single reporting period but is oriented towards long-term sustainability.

Its calculation on a consolidated basis represents a further distinctive element for MCC. The Group is characterized by an organizational model in which HR functions are distributed across individual entities rather than centralized. In this context, the development of a consistent and aggregated indicator at Group level takes on particular relevance, as it paves the way for overcoming the fragmentation of data and local management practices. The "Newborn" KPI is therefore collected according to shared and uniform

[30] Baby Planner, a new functionality within BBVA's app and website

[31] Sustainability Report of the Mediocredito Centrale Banking Group, published within the Management Report of the Consolidated Financial Statements, available at the following link: https://www.mcc.it/bilanci-financial-statements/.

methodological criteria across the different companies and subsequently consolidated, enabling an integrated and comparable view of parenthood dynamics within the Group.

This approach not only facilitates the identification of any misalignments or specific features across the various organizational entities, but also strengthens the overall consistency of human capital management policies, fostering the dissemination of best practices and the progressive alignment with common strategic guidelines. In this sense, the consolidated dimension of the KPI does not represent a mere aggregation exercise, but rather a governance lever that enables a systemic perspective, supports decision-making at a central level, and helps guide the evolution of HR policies towards an increasingly integrated and sustainable approach.

3. Hypotheses and Methods

3.1. Underlying assumptions and key considerations

The construction of the "Newborn" KPI is based on the assumption that administrative records related to leave represent a reliable proxy for parenthood events within the corporate population. In particular, the combined use of mandatory maternity leave and birth/paternity leave allows to systematically identify employees who become parents during the reference period.

However, as any indicator built on administrative data, the KPI is subject to certain points of attention that must be explicitly acknowledged.

A first element concerns multiple births (e.g., twin births). This case is mitigated in the Italian context[32], as the regulatory framework provides for a proportional extension of leave in the event of multiple births. This provides the means to correctly capture the number of children born, overcoming one of the main sources of underestimation typical of indicators based on individual events.

A second aspect concerns the non-use or partial use of leave by fathers[33]. Although the introduction of mandatory paternity leave has strengthened the

[32] Consolidated Act on Maternity and Paternity (Legislative Decree No. 151 of 26 March 2001), as subsequently amended, including Legislative Decree No. 105/2022 and the 2024 Budget Law.

[33] Mandatory paternity leave in Italy is currently governed by Legislative Decree No. 105 of 30 June 2022 (Article 2, paragraph 1, letter c), which introduced Article 27-bis into Legislative Decree No. 151/2001, making it a structural and permanent measure. It provides for 10

traceability of the phenomenon, differences in individual behavior or in administrative recording practices may still persist.

A further aspect relates to the risk of double-counting the same birth event in cases where both parents are employees of the Group. To avoid this duplication, the adopted model uses maternity leave as the primary reference for the identification of the event. In cases where the father, who is also an employee, takes paternity leave, the event is still recorded only once and uniquely attributed to the mother. In this way, methodological consistency is ensured and overestimation of the phenomenon is avoided.

A final element concerns adoptions and foster care arrangements which, within the national regulatory context[34], provide for leave entitlements equivalent to those for birth. This allows to include such events within the scope of the KPI, ensuring consistency with a broader definition of parenthood and reducing the risk of systematic exclusions.

Overall, the adopted methodology does not completely eliminate sources of error but significantly reduces their impact through indicator design choices that are consistent with the regulatory framework and with the available evidence, as described in paragraph 2.2.

A central element in the construction of the "Newborn" KPI is the awareness that the indicator represents an estimate rather than a perfect census measurement of the phenomenon. This choice should not be interpreted as a methodological weakness, but rather as a conscious trade-off between accuracy, operational feasibility, and compliance with regulatory constraints. In the context of ESG reporting, the absence of perfect data cannot justify the failure to measure relevant phenomena. On the contrary, the adoption of robust and transparent proxies creates the opportunity to initiate a path of accountability that brings to light dynamics that would otherwise remain unobserved. The explicit disclosure of the assumptions and limitations of the indicator therefore becomes an integral part of information quality: a declared and methodologically scrupulous estimate is preferable to an apparently precise figure whose construction is opaque. Accepting a certain degree of imperfection does not mean abandoning rigor, but rather adopting a pragmatic and responsible approach to measuring social sustainability, capable of evolving over time through the progressive improvement of data sources and methodologies used.

working days of leave, paid at 100% of salary for employed fathers, to be taken from two months before up to five months after the child's birth.

[34] Legislative Decree No. 151 of 2001, which regulates maternity leave, specifies that mandatory leave from work is granted to employed mothers, both biological and adoptive or foster mothers.

This KPI falls within the social dimension of ESG reporting, with specific reference to the S1 scope relating to own workforce. In particular, the indicator finds its natural placement within disclosure requirement S1-15 – work-life balance metrics, contributing to enrich the set of available metrics with a more direct and substantive measure of parenthood events.

The "Newborn" KPI set was introduced in the MCC Group's 2025 Sustainability Report[35] and is calculated by considering the number of children born to employees during the 2025 financial year, with a 2024 comparative, including a precise count of the actual number of births per event.

The scope of measurement includes all employees on the payroll during the reporting period.

The main information sources used are:

- mandatory maternity leave;
- birth/paternity leave.

The data is presented for each year with the following breakdowns:

- Number of births by gender and by parent category[36].
- Number of births by gender and by parent's geographical area[37].
- Number of births by gender and by age group[38].

As the "Newborn" KPI is not a standard ESG "core" KPI, but rather a complementary KPI, it should be interpreted in light of the Group's people- and well-being-oriented strategy. It is therefore necessary to associate the "Newborn" KPI with the following indicators:

- % of employees returning to full-time work after parental leave: the 12-month return rate is calculated as the ratio between the number of employees still in the workforce 12 months after the child's birth date and the total number of employees who became parents in the same reference year. The indicator is broken down by gender and by year (2024 and 2025). In cases where the 12-month period has not yet fully elapsed at the reporting date, the figure is calculated only for those positions for which the observation period has been completed;
- Gender pay gap for employees who became parents: the gender pay gap is calculated with reference to the population of employees who became parents in 2024 and 2025, comparing the average gross annual salary (RAL) of women with that of men within the same scope. The indicator

[35] Mediocredito Centrale (2025). Consolidated Sustainability Reporting: https://www.mcc.it/bilanci-financial-statements/.

[36] By gender and professional category (Executives, Middle Managers, Employees).

[37] By gender and geographical area (North-East, North-West, Centre, South), based on the employee's organisational assignment at the time of the child's birth.

[38] By gender and age group (age <30; 30–40; >40), calculated as of the child's birth date.

is determined according to the following formula: [average male RAL – average female RAL] / average male RAL, broken down by category (clerical staff, middle managers, executives).

The KPIs constructed in this way shift the focus from the birth event to actual support, providing a more accurate representation of the MCC Banking Group's concrete commitment to its people and to a genuinely inclusive organizational culture. The value of corporate action does not end with observing the birth event, but is measured above all in the organization's ability to reintegrate parents at the end of their parenthood experience, ensuring professional continuity, sustainable return conditions, and equal development opportunities.

From this perspective, indicators, such as the post-leave return rate, 12-month retention, maintenance of full-time employment, access to flexibility tools, and career progression following return, assess whether the maternity or paternity journey is truly supported by effective measures and does not become a factor of professional disadvantage. The focus therefore shifts to the quality of retention and the ability of each parent to fully reintegrate into corporate life, preserving skills, motivation, and engagement.

Particular importance is also placed on the protection of financial well-being, especially for women. The period following birth can represent a phase of greater economic vulnerability, in which the risk of involuntary reduction in working hours, slower career progression, or exit from the labor market has a more pronounced impact on women. Monitoring specific KPIs allows to oversee these dynamics and to "safeguard" the economic autonomy of female employees, supporting the maintenance of adequate salary levels, contribution continuity, access to professional opportunities, and full participation in corporate growth.

In this sense, these indicators become a strategic lever for social sustainability: they not only measure the effectiveness of HR policies, but also strengthen the MCC Group's ability to create a work environment in which parenthood does not represent an obstacle, but rather a dimension of life that is compatible with professional fulfillment and long-term economic prosperity.

3.2. The privacy issue: how far can (and should) HR go

The development of indicators linked to employees' personal sphere, such as those related to parenthood, inevitably raises significant issues in relation to personal data protection. In this area, the HR function is required to operate within a delicate balance between information needs and compliance with the principles of data minimisation and proportionality. The approach adopted for the "Newborn" KPI is based on the exclusive use of administrative data

available within corporate systems, collected for legitimate purposes related to employment management (e.g. leave administration). Accordingly, no additional collection of sensitive information is introduced, nor are employees required to provide self-declarations. Furthermore, both the construction and the disclosure of the indicator, are carried out on an aggregated and anonymised basis, preventing any possibility of individual identification, in line with the principles of data protection legislation[39].

This approach defines a clear boundary: HR can (and must) measure phenomena that are relevant to the social sustainability of the organisation, but it must do so using data that were hitherto lawfully available and limiting the analysis to what is necessary for reporting and organisational improvement purposes.

4. Results and Discussion

The application of the "Newborn" KPI to the 2024 and 2025 financial years provides a structured representation of parenthood within the corporate population, highlighting significant differences across the main analytical dimensions: gender, age, professional category, and geographical distribution.

The data analysis, highlights, first of all, the distribution of birth events between men and women, as well as their concentration within specific age groups, providing useful insights into the demographic structure of the workforce. The breakdowns by category and geographical area helps to identify potential organisational patterns, such as the varying incidence of parenthood across roles or regions.

In this context, the tables serve not merely a descriptive function but also an interpretative one, supporting the identification of trends, discontinuities, and areas of attention for corporate policies. As shown in the following table elaborated by the authors (table 3), in 2025, the total number of newborns within the Group amounted to 43, down from 51 recorded in 2024. The gender distribution of parents was substantially balanced (23 women and 20 men), confirming the broad uptake of parenthood support measures across the workforce. The Professional Area recorded the highest number of births, accounting for more than 75% of total newborns, in line with the composition of the corporate population. Compared with 2024, there was also an increase in births among Executives (from 1 to 5), while the number of births among

[39] GDPR (EU Regulation 2016/679), applicable since 25 May 2018, supplemented by the Italian Privacy Code (Legislative Decree 196/2003), as substantially amended by Legislative Decree 101/2018.

Middle Managers and Professional Area employees declined. The incidence of newborns relative to the total workforce stood at 1.57%, slightly in decrease from 1.85% in 2024, reflecting the overall annual trend.

Number of births by gender and by parent category

	2025			*2024*		
Job grade	*Woman*	*Man*	*Total*	*Woman*	*Man*	*Total*
Executive	3	2	5	0	1	1
Middle Manager	0	5	5	6	5	11
Professional Area	20	13	33	21	18	39
Total "Newborn"	23	20	43	27	24	51
Total Group	1.258	1.489	2.747	1.243	1.511	2.754
%	1,83%	1,34%	1,57%	2,17%	1,59%	1,85%

Table 3 - Relationship between number of births divided by gender and category and the workforce and relative percentage

In 2025, the number of newborns decreased in the Central area of the Peninsula (from 28 to 18), while it slightly increased in the “Mezzogiorno” (from 23 to 25), confirming a balanced geographical distribution across the Group (table 4).

Number of births by gender and by parent’s geographical area

	2025			*2024*		
Geographical area	*Woman*	*Man*	*Total*	*Woman*	*Man*	*Total*
Center	13	5	18	13	15	28
Mezzogiorno[40]	10	15	25	14	9	23
Total "Newborn"	23	20	43	27	24	51
Total Group	1.258	1.489	2.747	1.243	1.511	2.754
%	1,83%	1,34%	1,57%	2,17%	1,59%	1,85%

Table 4 - Distribution of births by gender and geographical region, relationship with the workforce and relative percentage

[40] “Mezzogiorno” in Italy, is used to indicate the Southern part of the Country. It generally includes the regions of Abruzzo, Molise, Campania, Puglia, Basilicata, Calabria, Sicilia, and Sardegna

In 2025, most newborns were recorded among employees aged 30–40 (30 out of 43), confirming this age group as the most represented among new parents within the Group (table 5).

Number of births by gender and by age group

	2025			*2024*		
Age	*Woman*	*Man*	*Total*	*Woman*	*Man*	*Total*
Less than 30 years	1	1	2	1	0	1
30-40 years	19	11	30	18	14	32
More than 40 year	3	8	11	8	10	18
Total "Newborn"	23	20	43	27	24	51
Total Group	1.258	1.489	2.747	1.243	1.511	2.754
%	1,83%	1,34%	1,57%	2,17%	1,59%	1,85%

Table 5 - Breakdown of newborn by gender and parent's age range, with year-over-year comparison and relationship with the workforce

As shown in the following table elaborated by the authors (table 6) the vast majority of employees return to full-time work, with women showing a very high retention in full-time roles instead of the typical shift toward part-time.

% of employees who returned to full-time work

	2025			*2024*		
	Woman	*Man*	*Total*	*Woman*	*Man*	*Total*
Total requested leaves (mandatory + voluntary)	106	39	145	88	42	130
of which employees who returned to full-time work	*96*	*35*	*131*	*84*	*40*	*124*
of which employees who returned to part-time work	*10*	*0*	*10*	*4*	*0*	*4*
of which employees who left the company	*0*	*4*	*4*	*0*	*2*	*2*
% of employees who returned to full-time work	90,60%	89,70%	90,30%	95,50%	95,20%	95,40%

Table 6 - Percentage of employees returning to full-time work following mandatory and voluntary leave, including a breakdown of part-time returns and departures by gender

In 2025, the gender pay gap for employees becoming parents persists across all measurable categories, ranging between 12.50% and 14.00% (table 7). The gender pay gap for new parents remains under close monitoring; we will track this data in the coming years to ensure that parenthood does not negatively impact the salaries of women, who are typically the most disadvantaged category.

Gender pay gap for employees who became parents for the year 2025 and the year 2024

	2025			*2024*		
	Average female gross annual salary (RAL)	*Average male gross annual salary (RAL)*	*Gender pay gap*	*Average female gross annual salary (RAL)*	*Average male gross annual salary (RAL)*	*Gender pay gap*
Executive	-	-	n.a.	-	155.000	n.a.
Middle Manager	66.322	77.110	14,00%	53.742	62.666	14,20%
Professional Area	39.877	45.579	12,50%	43.993	39.487	-11,40%

Table 7 - Average gross annual salary divided by gender and Gender pay gap for new parents by job category (2024-2025)

4.1. From data to strategy: the Newborn KPI as a "system-level" indicator

The "Newborn" KPI is not designed as a performance indicator, but rather as a context indicator. It does not measure "how well the organisation performs", but describes a structural phenomenon – parenthood – that has a cross-cutting impact on multiple dimensions of organisational life.

From this perspective, the value of the KPI lies in its ability to function as a system-level indicator, i.e., as an entry point for broader analyses of social sustainability. The birth data, in itself neutral, acquires meaning only when read in relation to other indicators and to existing corporate policies.

This approach ensures the avoidance of misleading interpretations (for example, considering a higher number of births as either "positive" or "negative") and to focus on the organisation's ability to respond appropriately to emerging needs.

The analysis of the "Newborn" KPI highlights strong interconnections with several key areas of the sustainability strategy:

- Work-life balance: birth data represents a direct driver of demand for work-life balance tools, making the potential need for organisational flexibility visible.
- Parenthood and caregiving: the KPI helps frame parenthood as part of a broader spectrum of care responsibilities, supporting an integrated reading of caregiver-related policies.
- Corporate welfare: the quantification of birth events supports the design and sizing of targeted welfare measures (e.g. financial contributions, childcare services, return-to-work support).
- Attractiveness and retention: the ability to effectively support employees during family transition phases is a key driver of organisational attractiveness and long-term retention.

In this area lies one of the most innovative elements of the approach adopted by MCC (as stated in paragraph 2.3): the shift away from fragmented or predominantly reactive measures, traditionally focused on the short term, towards structured planning oriented to long-term sustainability.

MCC aims to leverage the "Newborn" KPI and related indicators not only as monitoring tools, but as informational foundations for designing policies capable of supporting new parents throughout the entire post-birth journey, well beyond the duration of mandatory leave. The objective is to transform data into a governance lever, integrating such evidence into decision-making processes and into the planning of HR and welfare initiatives. Over time, this may translate into the development of structural measures such as agreements with nurseries and educational services, gradual return-to-work programmes, managerial coaching pathways for reintegration, advanced flexibility tools, financial support for parenthood, and initiatives dedicated to family well-being. The formalisation of these guidelines within the Sustainability Committee will strengthen the strategic oversight of the topic, ensuring alignment with the business plan, continuous monitoring of outcomes, and the progressive evolution of corporate policies.

From this perspective, attractiveness and retention do not depend solely on the ability to offer immediate benefits, but on the organisation's capacity to provide continuous support to individuals across different life stages. For new parents, this means being able to rely on an organisation that does not merely manage temporary absence, but creates propitious conditions for long-term, inclusive, and professionally rewarding employment.

As evidence of this, the "Newborn" KPI is embedded in a framework consistent with internal policies and Group manuals, contributing to the

monitoring of their effective implementation and impact[41], verifying the consistency between stated commitments and observed dynamics.

4.2. Communicating parenthood without creating exclusion

The communication of data related to parenthood requires particular regard in order to avoid unintended cultural and organisational effects, such as oversimplified interpretations, perceptions of intrusiveness, or potentially discriminatory interpretations. For this reason, the MCC Group adopts an approach based on responsibility, contextualisation, and exclusively improvement-oriented purposes, presenting such indicators as tools for organisational analysis and for guiding HR policies, and not as elements for individual assessment or judgement of personal choices.

This approach is fully consistent with the Group's journey on diversity, equity, and inclusion. MCC obtained, on April 23, 2026, the DEI (Diversity, Equity & Inclusion) certification[42], confirming its structural commitment to valuing people, ensuring equal treatment, and promoting inclusive working environments. This recognition strengthens the central role attributed to dimensions such as parenthood, work-life balance, the fight against gender bias, and the protection of equal opportunities, which are considered essential elements of the Group's social sustainability.

Within this framework, the measurement and communication of the "newborn" KPI and related indicators are embedded in an advanced model of human capital governance. Data analysis is aggregate, accompanied by appropriate methodological notes, and integrated with further qualitative and quantitative evidence, in order to support more informed decision-making and long-term policies. The objective is not to measure a private event, but to understand how the organisation can support new parents over time, remove potential barriers to full professional participation, and strengthen a fair, inclusive working environment capable of generating widespread well-being.

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[41] In particular, it is aligned with:

- Provision No. 1766 – Group Manual on parenthood and caregivers, which defines principles, tools, and support measures for employees with care responsibilities;
- Provision No. 1771 – Manual of the Gender Equality Management System, which promotes equity in career opportunities, remuneration, and access to rights.

[42] Cf Uni/PdR 125:2022, "Guidelines on the gender equality management system" released by Bureau veritas. Although Artigiancassa is part of the Group, it has not been included in the DEI certification, as it was acquired in December 2025 and is currently undergoing a complete reorganization.

The first risk of ineffective communication is the generation of implicit pressure, whereby parenthood is portrayed as a socially desirable norm. This can translate into cultural biases that may indirectly disadvantage those who do not have children, whether by choice or due to circumstances.

It is therefore essential to recognise the plurality of individual experiences, explicitly including:

- child-free individuals;
- infertility situations;
- life paths that differ from parenthood.

In this sense, responsible communication should:

- avoid solemn or prescriptive narratives of parenthood;
- use inclusive and neutral language;
- always contextualise data, clarifying its meaning and limitations;
- accompany the communication of birth-related data with information on support policies, emphasising that the focus is on inclusion rather than on the event itself.

5. Conclusions

Parenting is recognized as a significant national-level issue due to its profound impact on health of society, economic and social success, intergenerational stability and well-being. Rising challenges have elevated the need for structured support systems both at a national level and at a corporate level. Italy is currently addressing parenting as a pillar of its national strategy and, since banks have a significant public impact, it is advisable for them to contribute to a welfare system that begins within their own organization.

The contribution of the “Newborn” KPI, through an integrated reading with the other ESG and HR indicators presented, is part of this positive approach within the banking group, with a significant strategic impact, that helps drive healthy business growth by focusing on people. The combination of demographic data, work–life balance indicators, gender equity metrics, and qualitative information create the opportunity to build a systemic view capable of capturing the interdependencies between seemingly distinct phenomena.

From this perspective, the KPI does not represent a final point, but rather a node within a broader information network that supports more informed decision-making processes oriented towards long-term social sustainability.

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Health promotion and sports inclusion: A sustainable link

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Abstract
Health promotion is a socio-political process that enables individuals to gain greater control over their health and improve it, as outlined in the Ottawa Charter. It considers not only individual aspects but also social and environmental contexts. Within this framework, physical activity and sport play a central role, promoting physical and psychological benefits, well-being, and social integration. Promoting physical activity is a public health priority and requires coordinated interventions. Sports organizations represent key settings for health promotion and important educational models. The guidelines of the Health Promoting Sports Federation support these processes, with particular attention to inclusion.
Keywords: Health promotion; sedentary behavior; physical activity; sport; inclusion

1. Introduction

Health promotion is the global socio-political process that enables individuals to gain control over their health and improve it. It is a complex strategy involving multiple levels of intervention – individual, social, political, and environmental (WHO, 1987).

Indeed, the process of health promotion encompasses not only actions aimed at strengthening individuals' capacities and competencies, but also interventions designed to modify social, environmental, and economic

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conditions in order to mitigate their impact on both individual and collective health.

In recent years, also in light of these considerations, the definition of health has increasingly moved away from its traditional meaning. Today, health should no longer be understood merely as "a complete state of physical, mental and social well-being and not merely the absence of disease" (WHO, 1948), nor solely, as stated in Article 32 of the Italian Constitution, as a "right of every citizen that the State must guarantee and protect" (Italian Constitution, 1948).

Among the most recent and widely recognized definitions of health is that proposed by Fiona Godlee – Editor-in-Chief of the *British Medical Journal* from 2005 to 2021 – who, in a 2012 editorial, defined health as "the ability to adapt and self-manage in the face of social, physical, and emotional challenges that life inevitably presents" (Godlee, 2012).

Godlee criticizes the World Health Organization's 1948 definition, arguing that although historically significant, it is now considered limited in the 21st century. According to the author, rather than being a static state of "perfection" or absence of disease, health should be understood as a dynamic resource and a capacity for resilience (dynamic approach to health). This perspective would also allow individuals with chronic conditions or disabilities to be considered "healthy" if they are able to manage their condition and adapt to their environment (principle of inclusivity). In effect, the emphasis shifts from a clinical and disease-centered view (a medicalized perspective) to individual strength and personal responsibility in maintaining psycho-physical balance, thereby promoting a paradigm shift toward a more person-centered model of care.

When contextualizing the WHO's historical definition of health within the health promotion process, it can be argued that, in order to achieve a state of complete physical, mental, and social well-being, individuals and communities must be able to identify and realize their aspirations, satisfy their needs, and modify or adapt to their environment. Health, therefore, should not be considered exclusively as a state or a right, but as a dynamic resource for everyday life and, at the same time, not the ultimate goal of life itself. It is a positive concept that emphasizes social and personal resources, as well as individual physical capacities, in line with Godlee's perspective. Each person has the responsibility to improve their own health and to bring it to the highest level permitted by their psycho-physical conditions, social relationships, and environmental context. Regardless of the socio-environmental conditions in which they live, every individual can – and indeed has the right and responsibility to – improve their health.

Health promotion is not limited to the healthcare sector, but requires an intersectoral approach. The issue must be brought to the attention of decision-makers in all sectors and at all levels, encouraging them to be fully aware of the health consequences of their decisions and to assume responsibility accordingly. Health promotion policies integrate diverse but complementary components – legislation, fiscal measures, and organizational changes – into coordinated actions aimed at implementing health, social, and income policies inspired by greater equity (Sallis, 2016). Within the logic of health promotion, the principle of equity plays a crucial role. All individuals should have equal opportunities to achieve the highest attainable level of health, regardless of factors such as income, education, place of residence, gender, or origin, thereby avoiding unjust and preventable health disparities and promoting "proportionate universalism.

Health promotion policy must prioritize the identification of barriers that hinder the adoption of public policies that protect health across non-health sectors and determine the most effective ways to remove them. It is essential to ensure that, for policymakers as well, the choice to protect health becomes the most advantageous option.

Health is created and lived by people in their everyday lives: in the places where they learn, work, play, and love. Health is built through caring for oneself and others, developing the ability to make decisions and take control of life circumstances, and ensuring that the society in which one lives enables everyone to achieve health. Commitment, comprehensive support strategies, and attention to ecological sustainability are essential factors for the development of health promotion. For those involved in this field, a guiding principle must be that, at every stage of planning, implementation, and evaluation, men and women act together on a basis of full equality.

Health, as a primary good, must be integrated into broader political decision-making processes. This is because significant negative impacts on individual and collective health can arise not only from health policy decisions, but also from decisions in sectors such as energy, the environment, urban planning, transportation, waste management, and water supply.

Contemporary societies are highly complex and interdependent, and health cannot be treated as an isolated objective. The inseparable link between humans and the environment forms the basis of a socio-ecological approach to health (Green, 2005). The guiding principle should always be mutual support: caring for one another, for our communities, and for the natural environment. The protection of natural resources worldwide must

be reaffirmed as a global responsibility. Changes in lifestyles, work patterns, and leisure activities have a decisive impact on health.

Work and leisure should therefore become sources of well-being for all. The way in which society organizes work should contribute to making it healthier; health promotion should lead to safer, more stimulating, rewarding, and enjoyable living and working conditions. A systematic assessment of the health impact of rapidly changing environments—particularly in the fields of technology, labor, energy production, and urbanization—is essential and must be followed by actions aimed at ensuring tangible health benefits for all. Every health promotion strategy must take into account environmental protection and the conservation of natural resources. Effective community action can contribute to ensuring healthier and safer products and services, improved public services, and more supportive and health-promoting environments.

2. Physical Activity, Sport, and Health

A healthy lifestyle does not consist solely of proper nutrition and adequate physical activity; rather, it is a more complex construct that encompasses the effective use of leisure time, positive interpersonal relationships, greater awareness of what truly matters, and the ability to manage emotions and stress. Engaging in physical activity is a choice that can be highly beneficial for improving health and quality of life, particularly within the fast-paced rhythms of modern society. Extensive scientific evidence demonstrates that sport, and physical activity in general, not only provide significant benefits for psycho-physical health and overall well-being, but also enable individuals to enhance their role within the social context and improve interpersonal relationships.

Several key domains of influence of sport can be identified. First, health, due to the positive physical and psychological effects that, combined with healthy lifestyles, can prevent the onset of certain chronic diseases. Second, values and essential moral qualities fostered through sport, contributing to personal development, such as teamwork, respect for rules and discipline, social inclusion, sharing, and education. Third, the important educational and formative role of sport: over the past 20 years, sport has become a third pillar in the development of adolescents, alongside family and school.

The economic benefits of sport are also evident: it generates investment, employment, and impacts multiple sectors, including manufacturing, tourism, communications, technology, and the broader “Made in Italy”

system. In addition, sport has a significant environmental and territorial dimension. The sports sector increasingly engages with issues related to sustainability and environmental protection, aiming to strengthen the connection between sports culture and environmental awareness. It is therefore clear that all these elements contribute to social, economic, and environmental well-being.

Health promotion has always paid particular attention to the field of physical activity and sport. The 2016 Bangkok Declaration on Physical Activity for Global Health and Sustainable Development, endorsed by participants at the VI ISPAH (International Society of Physical Activity and Health) Congress on Physical Activity and Public Health, called on governments, policymakers, potential funders, and stakeholders – including the WHO, the United Nations, and major non-governmental organizations – to:

- renew their commitment to invest in and implement timely, large-scale policy actions to reduce physical inactivity across the life course, contributing to the reduction of the global burden of non-communicable diseases and the achievement of the 2030 Agenda goals;
- ensure cross-sectoral involvement at the national level and establish ad hoc coordination platforms; strengthen the competencies of professionals and decision-makers (ISPAH, 2015).

From a scientific perspective, the importance of physical activity as a health promoter is supported by the following evidence: approximately 30% of premature deaths are associated with overweight and physical inactivity; sedentary behavior causes 5.3 million deaths annually, exceeding those caused by tobacco smoking (5 million deaths); approximately one-third of cancer deaths are linked to poor diet, sedentary behavior, and overweight; engaging in physical activity even below recommended levels (30 minutes, five times per week for adults) produces beneficial effects, adding on average three years to life expectancy.

Sedentary behavior is considered an important independent risk factor. For this reason, in public health, physical activity – particularly when framed as preventive exercise (Adapted Physical Activity, APA) or as targeted interventions for multifactorial diseases (Therapeutic Exercise, TE) – is increasingly used as a form of "medicine," prescribed by healthcare professionals (HEPA, 2015; Zouhal, 2022).

Sedentary behavior and physical inactivity are distinct concepts and should not be confused, as highlighted by several studies (van der Ploeg, 2017; Calella, 2024; Pinsault, 2025). An individual may be physically active yet still sedentary. For example, a person who engages in sport regularly (e.g., three times per week) but spends most of the day in

sedentary activities (studying, working, leisure) is still considered sedentary. In other words, sedentariness is determined by the amount of time spent in low-energy activities compared to movement, making it a quantitative measure.

Sedentary behavior is an independent risk factor for the development of numerous diseases and depends not only on insufficient physical activity, but also on generally inactive lifestyles. Therefore, the negative effects of sedentariness cannot be reduced to those associated with low physical activity alone. The optimal condition for achieving tangible health benefits arises from regular physical activity within an overall active lifestyle. Engaging in physical activity is thus a necessary but not sufficient condition for maintaining a healthy lifestyle.

According to the Ministry of Health, promoting physical activity is a priority that can only be achieved by effectively addressing the environmental, social, and individual determinants of physical inactivity (Bauman, 2012) and by implementing sustainable actions through cross-sectoral collaboration at national, regional, and local levels. This represents a complex process requiring the involvement of multiple sectors, each with specific roles and responsibilities: public health and healthcare systems, education, non-health professionals, the sports sector, environmental and infrastructure planning, and workplaces.

In particular, according to Van Hoye (2016, 2020, 2021), in line with the principles of the Ottawa Charter and health promotion, promoting health through sport and physical activity involves:

Building healthy public policy, by prioritizing health at all levels of sport and raising awareness among decision-makers about the impact of their choices. This includes developing partnerships across sectors such as urban planning, fiscal policy, education, transportation, leisure, media, and family policies, with the aim of making healthy choices easier.

Creating supportive environments, by ensuring safe, stimulating, and enjoyable spaces for sport and improving the well-being of athletes and participants.

Strengthening community action, enabling communities to make decisions, set priorities, and plan strategies to promote physical activity. This involves empowering sports federations and clubs through accessible information, quality practice, learning opportunities, partnerships, and funding.

Developing personal skills, by encouraging lifelong personal and social development through sport, enhancing individuals' control over their health, and paying particular attention to vulnerable groups.

Reorienting health services, encouraging the sports sector to view participants not only as athletes but as individuals in their entirety, and recognizing the role of sports organizations in promoting health and healthy lifestyles. Health services should support physical activity through education, counseling, monitoring, and tailored interventions for individuals with specific conditions or disabilities.

3. Sport and Inclusion

Sport represents a privileged context for promoting social inclusion. It constitutes an important opportunity for personal growth for every individual, regardless of their personal and social conditions, and serves as a means of social transformation. It can act as a powerful factor of humanization, contribute to the realization of values such as beauty and goodness, and improve health – understood in its broad conceptual sense – as well as quality of life and social inclusion (Moliterni, 2013).

A person-centered approach to sport can foster processes of inclusion and social cohesion for both individuals with typical development and those with disabilities. It allows individuals to explore deeper aspects of the self through interaction with others' differences and challenges, while also engaging in meaningful experiences such as interpersonal communication, cooperation, respect for rules, solidarity, fairness, justice, increased motivation, and the ability to face and overcome frustration (Mura, 2009).

For over twenty years, in many European and non-European countries, the recognition of Adapted Physical Activity (APA) as a discipline has enabled the adaptation of all major forms of physical activity: from physical education in schools to the initiation of sport in clubs, from rehabilitation and therapeutic practices to recreational activities, from maintenance exercise to competitive sport. Based on the principles of human dignity (Article 1) and accessibility (Article 9) reaffirmed by the United Nations Convention on the Rights of Persons with Disabilities (UN, 2006), it is essential to promote motor and sports activities as a strategy for fostering inclusion, developing new cultural awareness, and reshaping policies of access and participation. These activities should be implemented in an integrated manner, involving both individuals with difficulties and the general population, within formal and informal contexts. As noted, "it is a matter of redefining the trajectory of movement and sport within a dimension where barriers and boundaries disappear, making them human-centered practices open to all, everywhere" (Mura, 2011).

Adapted Physical Activity is specifically designed for populations with special needs, for whom not only sports practices but also environments, equipment, and regulations are adapted. Moreover, the importance of APA is recognized by the International Federation of Adapted Physical Activity (IFAPA), which applies it across education, leisure, high-performance sport, and rehabilitation, without distinction in its conceptual and pedagogical framework (de Anna, 2009).

The key challenge is to design motor and sports activity programs for all individuals – regardless of ability level or age – that respect individual differences while ensuring personal satisfaction, performance improvement, and, above all, full inclusion within mainstream contexts (Mura, 2009). The goal is not to alter the reality of sport solely to meet the needs of people with disabilities, but rather to rethink, modify, and adapt existing activities to enable broader participation. This may also involve the development of new disciplines that incorporate and enhance diversity within their rules and structures. As emphasized, "the aim is not merely to ensure participation, but to highlight the enhancement of each individual's abilities by designing activities that require more flexible timing and modalities tailored to specific needs" (de Anna, 2011).

In all contexts where physical and sports activities take place, it is now necessary to develop multi-level pathways that allow individuals to progressively build their motor and sports competencies – from basic skills to more advanced and complex abilities – within a fully inclusive and socially integrated environment, consistent with the principles of health promotion.

4. WHO Guidelines: Health-Promoting Sports Organizations

According to the World Health Organization, "when individuals perceive that their health and well-being are a priority for sports federations and associations, they are more likely to invest their own resources to strengthen these organizations' capacity to promote health. This improves the performance of elite athletes and contributes to retaining members, coaches, and managers, creating a virtuous cycle that can generate multiple positive outcomes, including economic benefits" (WHO, 2025).

The world of sport plays a key role in society by striving to create optimal conditions that encourage sports federations, athletes, and members to take care of their health and well-being. To this end, the Health Promoting Sports Federation (HPSF) has recently developed specific guidelines aimed at supporting investments by sports federations and clubs

(and their partners), providing them with theoretical models, case studies, expertise, strategies, and tools to promote the health of their members through concrete actions.

According to the WHO, being a Health-Promoting National Sports Federation (NSF) means integrating the concept of health into organizational values, vision, and leadership, as well as into activities and training programs, while supporting affiliated clubs in becoming Health-Promoting Sports Clubs (HPSC).

It is essential for NSFs to collaborate in a synergistic and integrated manner with health promotion organizations, as well as with private partners, in order to mobilize their health promotion potential and enhance the visibility of health-related initiatives.

Enhancing awareness of the strong link between sport and health will increasingly attract the attention of parents concerned with the growth and development of children and youth, as well as that of funders interested in the social and health responsibilities of sports organizations.

5. Conclusions

The Ottawa Charter has been a valuable tool in guiding scholars and practitioners in health promotion in the design and implementation of policies, strategies, and programs.

However, the document has remained unchanged despite the fact that the world and people's health needs have evolved significantly. Health promotion represents a fundamental strategy for addressing contemporary health challenges. At present, the Ottawa Charter is no longer fully capable of responding to these challenges, as a long-anticipated revision has yet to be carried out. Nevertheless, the prerequisites for health and the core strategies of health promotion, with some adjustments, remain relevant in today's context. The five priority action areas for health promotion – building healthy public policy, creating supportive environments, strengthening community action, developing personal skills, and reorienting health services – require urgent updating, that better reflect the challenges of the modern era.

An inclusive approach should be adopted, under the guidance of a competent international organization, in collaboration with non-governmental and voluntary organizations, social movements, health promotion professionals, and governments, in order to revise or replace the document developed in Ottawa approximately 40 years ago.

A comprehensive revision – or replacement – of the Ottawa Charter should take into account: contemporary perspectives, concepts, definitions, and language used in modern health promotion, including "One Health," health literacy, health as a social construct, social determinants of health, inclusion, resilience, and equity; the new global challenges in health promotion that have emerged over the past 40 years, including emerging infectious diseases, the increase in armed conflicts, social isolation and mental health issues, urbanization, the impact of the Internet and social media, artificial intelligence and digital technologies, mass migration, the climate crisis, food insecurity, and the growing economic and social inequalities (Dors, 2026).

Within this perspective, the field of sport and physical activity must assume a decisive and indispensable role in any authoritative document that aims to redefine the role of health promotion in the contemporary world.

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...Un orologio, metafora del tempo, scandisce l'inizio di una sequenza catartica...
I valori, la conoscenza, la partecipazione e l'ambiente come i meccanismi di un orologio antico sono a vista, correlati e perfettamente sincronizzati tra di loro, e come gli ingranaggi di un meccanismo funzionante essi sono posti a sostegno del futuro dei giovani.
È così che il volto del giovane, ormai uomo, reso forte ed ottimista per la conoscenza acquisita, guarda verso il futuro, verso i suoi obiettivi, qui rappresentati dalla stella e dall'orizzonte: egli è pensoso ma anche sereno, poichè è certo di poterli raggiungere.
L'elemento acqua-mare, sintetizzato con due lievi onde marine, è l'ambiente ideale in cui tutti vorremmo perderci entro una dimensione temporale illimitata che va oltre la realtà.

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